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the glass industry

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CYRIL B. DELGADO, Editor and Business Manager
KATHERINE A. HOWE, Production Editor

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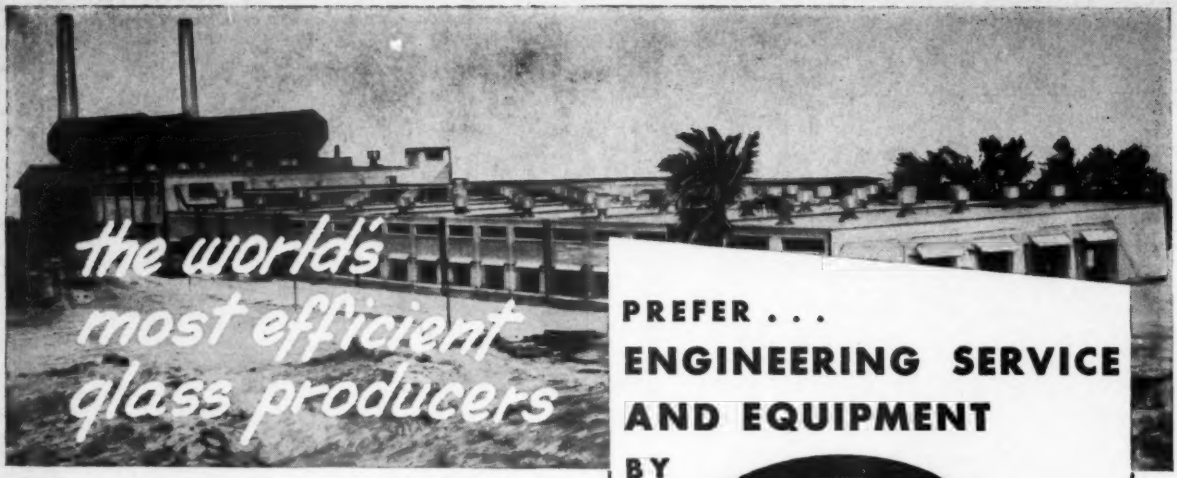

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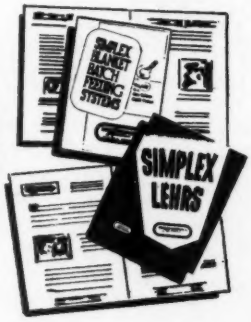

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TANK FURNACES • BATCH CHARGERS • BATCH HANDLING SYSTEMS • PRODUCER GLASS PLANTS • DECORATING AND ANNEALING LEHRS • STACKERS • COMPLETE PLANTS

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the glass industry
VOLUME 36, NUMBER 6, JUNE, 1955

National Advertising For Glass Containers

Details of new advertising and public relations program presented at G.C.M.I. Annual Meeting.

THE GREENBRIER in White Sulphur Springs, West Virginia, was again the meeting place for the Glass Container Manufacturers Institute's 11th Annual Meeting on May 9, 10, and 11.

While the Institute's regular business, such as the reports of the nine standing committees, election of officers and trustees, and routine matters, was conducted as usual, the outstanding topic of discussion was the new marketing, advertising and public relations program to which the glass container manufacturers are currently undertaking. In this connection, much has happened since the previous Semi-Annual Meeting of the G.C.M.I. held in Colorado Springs in October of last year, during which plans for a marketing and advertising program were discussed and broadly outlined. In the intervening six months, a comprehensive marketing, advertising and a public relations program has been brought to fruition and within the next few weeks, the first evidence of this carefully conceived promotional effort will be seen in five national women's magazines, a national TV home program, trade paper advertising, special dealer aids and a number of well-organized public relations projects.

The meeting opened with a review of the progress of the Market Research and Promotion Committee by its Chairman, Franklin B. Pollock, Board Chairman of Thatcher Glass Mfg. Company. Following this, R. L. Cheney, the Institute's Director of Marketing, started the ball rolling for the presentation of the advertising and promotional program.

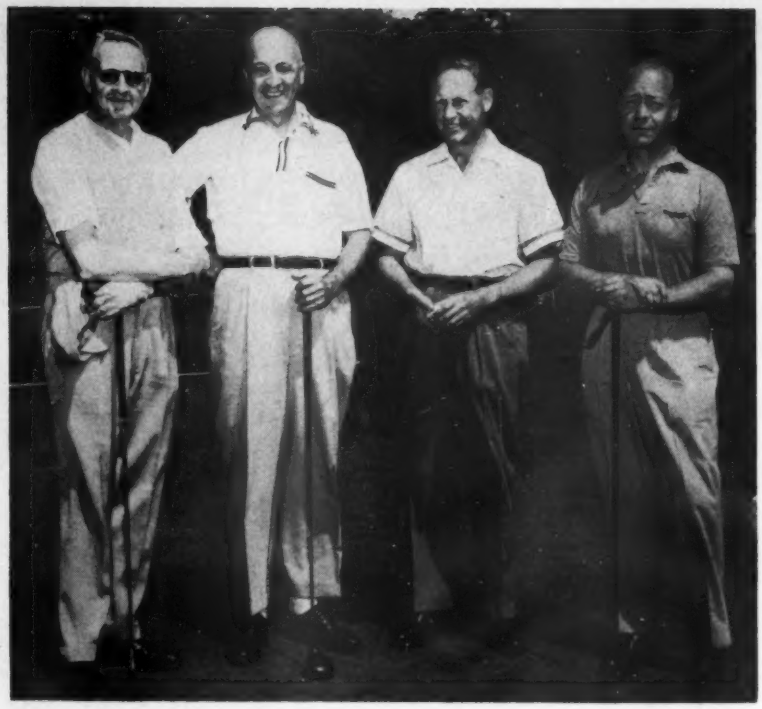
R. B. Semple, Wyandotte Chemicals Corp.; R. L. Cheney, G.C.M.I.; T. D'A. Brophy, Kenyon & Eckhardt.

The thoroughness of the planning of this national promotional effort, designed on one hand to hold and on the other to expand markets for glass packaged products, was exemplified by the detailed presentation by a team working with Mr. Cheney and his Assistant Director of Marketing, Bush Barnum. The team was composed of staff members of Kenyon & Eckhardt, Inc., the advertising agency selected by G.C.M.I. to carry out the advertising and promotional job. Each phase of the effort was covered by the individual specializing in the particular problem.

G. Maxwell Ule, the agency's Director of Research, described how the over-all strategy was developed and pointed out how G.C.M.I.'s own basic research and the agency's continuing work along this line had produced guides to insure that the advertising is beamed correctly and efficiently. Mr. Ule emphasized that previous research work done by G.C.M.I. has saved many months of time and enabled a faster take-off of the promotional effort.

Miss Leslie Munro, Kenyon & Eckhardt's specialist in woman-appeal advertising, described the philosophy behind the basic copy approach to be employed.

Robert B. Shirey, K&E Account Executive, then unfolded the working details of the extensive program in an address entitled "The Way to Success in Association Advertising." Thomas D'A Brophy, Board Chairman of Kenyon & Eckhardt, presented some outstanding examples of the benefits which are derived by an industry acting in unison through its association in consistently selling an "idea" through advertising.



V. L. Hall, G.C.M.I.; H. W. Gleichert, Columbia - Southern Chemical Corp.; C. C. Merrifield, Econametric Institute; P. G. Fuger, Wyandotte Chemicals Corp.

Mr. Brophy also interestingly presented some statistics on the packaging industry, including containers of all types. It was pointed out that glass containers had 8% of the total packaging market in 1953, while metal cans enjoyed 14% of the market. However, when the re-use factor of certain bottles is considered—milk, soft drinks, etc.—the total sale of glass packed units in the United States in 1953 was 74.5 billion, an average of 465 per capita. Shipments of metal cans for that year totaled 35.6 billion units. Therefore, American consumers bought more than two glass packed items in 1953 for every one that was packed in metal during that year.

Toward the close of the three-day meeting, G.C.M.I.'s Secretary-Treasurer, Harry W. Kuni, described the Institute's participation in the Federal Civil Defense Administration program to test food under atomic explosion conditions. Mr. Kuni and John Sharf, of Armstrong Cork Company, were the glass container industry's representatives at the Nevada test site.

A talk by Jack Lacy, Lacy Sales Institute, on "What Makes Star Salesmen Tick?" was well received by the

(*Continued on page* 338)

C. R. Megowen, Owens-Illinois Glass Company; H. W. Kuni, G.C.M.I.; G. Thornton, Ottawa Silica Company; S. F. Davis, Owens-Illinois Glass Company.

A Review of the Glass Division Program in Cincinnati

● THE 57TH ANNUAL MEETING of the American Ceramic Society was held at the Sheraton-Gibson Hotel, Cincinnati, Ohio. The Program Committee, composed of F. W. Mowrey, John W. Michener and Frank R. Bacon, had arranged over thirty Glass Division papers, including the various symposia on related subjects.

F. L. Bishop, Kimble Glass Division, Owens-Illinois Glass Company; N. J. Kreidl, Bausch & Lomb Optical Company; F. W. Mowrey, American Window Glass Company; and August C. Siefert, Owens-Corning Fiberglas Corporation, served as chairmen of the various meetings.

The first paper, "Some Physical Factors Affecting the Internal Damping of Glass," was by S. L. Blum, Raytheon Manufacturing Company. Dr. Blum stated that a technique used by metallurgists, as well as ceramists, was employed to measure accurately the internal damping of fine glass fibers in vacuum at constant temperature. The glass used had the following composition: SiO_2—72.7%, Al_2O_3—1.6%, Sb_2O_3—1.0%, CaO—4.7%, MgO—3.2%, K_2O—0.2%, and Na_2O—16.4%. Glass fibers were chosen as test samples because the flaw concentration on the surface was greatest on this type of sample. After drawing, the samples were coated with paraffin wax and stored in vacuum. Extreme care was used to avoid any scratching or marring of the surface.

The geometry of the fiber was found to have an effect on damping in air. Etching with HF was more pronounced with chilled fibers than annealed, and water-soaked fibers gave an increase in the internal damping. The latter was believed to be due to the influence of OH^- ions on the structure of the glass. The effects of viscous air damping and vacua on torsional oscillation in the apparatus were also discussed since absolute internal damping values were desired.

It was suggested that further studies of this type may offer a means of studying the effects of annealing and chilling on the structure of glass.

The next paper, "Infrared Spectra and Atomic Arrangement in Fused Boron Oxide and Soda Borate Glasses," by Scott Anderson, R. L. Bohon and D. D. Kimpton, The Anderson Physical Laboratory, was presented by Mr. Kimpton. The infrared absorption spectra of fused B_2O_3 and a series of sodium borate glasses were shown. These spectra were obtained using vacuum pressed briquettes of the powdered glass and powdered K Br.

The spectrum of fused B_2O_3 demonstrated quite definitely that this glass does not consist of a 100% continuous triangularly coordinated network. The spectrum indicates that H-bonds play an important role in the atomic arrangement of the glasses of zero or low soda content. It appeared that the B_2O_3 glass consisted of complexes of an approximate size (B_9O_{14}) held together by H-bonds. About one in nine of the borons appeared to be tetrahedrally coordinated. The low soda-content glasses were similar. As the Na_2O content was increased beyond 15%, the atomic arrangement was believed to be quite different from that found in glasses with 10% or less Na_2O.

The next paper, "A Basic Study of the Structure of Hyper-Eutectic Glasses and Their Characteristics: Structure," by R. L. Hess and R. K. Gupta, University of Michigan, was presented by R. L. Hess.

The concept of the structure of glass presented in this paper was a dynamic one, representing a deviation from the usual concept of an "average" structure. It was felt that a dynamic concept of the structure of glass would be very helpful in explaining the various characteristics of this important material of construction. A descriptive and graphic illustration of the structure of silica melts and of the role played by X_2O, first group elements, and YO second group elements, separately and together in silica melts was presented. This role was shown to be a structural one and not merely the filling of holes in an otherwise normal silica structure. The effects were described on the basis of "doublets" and "triplets."

The next paper, "The Study of Glass by Nuclear Magnetic Resonance," was by G. R. Holzman, Mellon Institute of Industrial Research.

Mr. Holzman stated that every atomic nucleus with a magnetic moment appearing in glass may be used as a probe for studying the physical chemistry of its surroundings. The study was accomplished by first inserting the glass in a magnetic field which oriented individual magnetic moments and established a magnetic set of energy levels. Each nucleus distinguished by its moment has its own set of energy levels and according to the quantum theory, the difference between two of these levels is equal to a quantum of energy hv. The frequency associated with this hv is found to lie in the radio-frequency portion of the electromagnetic spectrum. Immersing the glass or glass fiber in radiation of a specific frequency will cause particular nuclei to absorb energy from the radiation. Study of the absorption may yield new information on such matters as the chemical components of glass, the structure, chemical bond character, and diffusion and internal friction processes.

"Hydrogen Treatment of Lead Glass for High-Voltage Electron Tubes," by John Gallup and Leona Mogey, Radio Corporation of America, was the next paper. It was presented by Mr. Gallup.

A technique used to increase the life of high-voltage electron tubes was described. A hydrogen treatment was used in high-voltage rectifier tubes such as the 1B3-GT to minimize the harmful effects of high-voltage electron bombardment and thereby extend the life of the tube. The process included heating the lead-glass bulbs in an atmosphere containing from 5 per cent to 100 per cent hydrogen for 10 to 30 minutes at temperatures ranging from 180° C. to 450° C. The effects of variations in firing time and in temperature were discussed. The results of

the hydrogen treatment concerning the electrical and mechanical resistance of the glass were also discussed, and tests used to differentiate between treated and untreated bulbs were described. Conditions needed to obtain satisfactory treatment were evaluated. The treatment provided a layer having lowered electrical resistance which dissipated localized high potentials. This layer had increased resistance to mechanical shock and abrasion and to weathering and chemical attack. It also retarded the emission of gas in the operating tube and thus prevented gas arcs during the life of the tube. The procedure was not effective on lime glass.

Tuesday morning's session, which was devoted to a "Symposium on Sealing," was preceded with a few opening remarks by Dr. Louis Navias, General Electric Co.

Dr. Navias was session chairman of a most interesting series of papers devoted to sealing. He pointed out that the present-day electronics industry is based on glasses and metals, as well as their union. The mechanism of adherence between glasses and metals and between ceramics and metals is as varied as the components themselves. Sealing is a combination of dissimilar materials effected by bonding. These materials may be glasses, metals and crystalline ceramic bodies. The problem of their union is the problem of sealing. The symposium was intended to divulge recent knowledge gained in studying the reactions and mechanism of adherence.

The first paper to be presented Tuesday was "Expansion, Setting Point and Stress Relations in Glass-Metal Seals" by F. W. Martin, Corning Glass Works. Mr. Martin pointed out the relation of "expansion match" of metal and glass, and the important factor was said to be differential expansion. The expansion match is usually determined as glass and metal are cooling. Comparative curves of glasses and metals were shown and the various critical regions indicated.

Mathematical treatment of the stress distribution at the seal was given to show the most desirable characteristics, especially in a cylindrical seal. The importance of geometry in determining the setting point in internal seals was stressed. Methods of estimating the setting point were discussed and results of calculations presented. The factor of void spaces was pointed out as being highly important especially when powders were used in sealing. Applications of typical sealing problems were given by illustrative examples.

The second paper in this session was "Fundamental Thermal Stress Analysis of Enamel-Metal Systems," by J. H. Lauchner, R. L. Cook and A. I. Andrews, University of Illinois, and was presented by Mr. Lauchner.

A technique for measuring and recording strains developed in an enameled strip during heating was described. A photoelectric cell was incorporated as a means of measuring strain. The strain-temperature relationship of enameled metal strips was automatically recorded as x-y coordinates by a function plotter. Metal and coating thicknesses were related to strain and the corresponding stress values calculated. It was shown that the rate of heating during strain measurements and the previous thermal history markedly influenced the strain in enameled-metal composites.

The next paper, "Why Thermodynamics Does Not Give the Correct Answers to Many Sealing Problems," was by Leo Brewer, University of California.

Mr. Brewer pointed out that the importance of the concept of net reactions has not been sufficiently emphasized, and many erroneous conclusions have been drawn from thermodynamic calculations carried out without proper consideration of the net reaction. The reactions of titanium in particular were considered, e.g., Ti and BeO, Ti and Gd_2O_2, Ti and ZrO_2, and Ti and Al_2O_3.

As an aid in this type of calculation, data were given from the U. S. Bureau of Mines and others. New methods of calculation permit thermodynamic calculations to be carried out with little labor and high speed. Since a variety of phases are present and may play an important role in the sealing of metals and glass, further fundamental knowledge is badly needed.

The next paper was "The Role of Surface Tension and Wetting in Metal-Ceramic Sealing" by W. D. Kingery, Massachusetts Institute of Technology.

Dr. Kingery considered the application of surface tension and wetting data to various sealing processes. The flow of liquid between two plates, the flow of liquid into a joint, and the influence of horizontal and vertical joints on the manner of flow were fully discussed. It was pointed out that irregularities in the surface may alter the tendency to seal, as well as the flow process. The relationship among surface tension, wetting properties and sealing behavior was described. It was recommended that fundamental data be applied cautiously because the effects of very minor impurities may alter considerably the value of certain factors.

The next paper, "Effect of Temperature and Oxide Additions on the Wettability of Metals by Glass," was by R. M. Fulrath, S. P. Mitoff and J. A. Pask, University of California. It was presented by Mr. Fulrath.

A technique for measuring wettability was described, based on the measurement of the contact angle created by the union of glasses and metals. The experiments were carried out in a high degree of vacuum utilizing simple silicate base glasses and precious metals.

The effect of metal oxide additions to the glasses was determined in order to correlate interfacial energy-surface energy relations in wetting experiments. The mechanism of wetting in glass-metal systems was discussed on the basis of interfacial energy considerations.

The next paper was "Nature of Adhesion" by Frank W. Reinhart, National Bureau of Standards.

Mr. Reinhart pointed out that adhesion was attributed to the forces of attraction between atoms and molecules; namely, electrostatic, covalent and metallic bonds, and secondary or van der Waals forces. Secondary forces are probably responsible for most cases of adhesion, although the others are also operative in certain specific systems. These forces of attraction are operative to the extent that molecular nearness between adhesive and adherend is attained. This nearness required that the adhesive become liquid at some point or that it be synthesized in contact with the adherend. Changes in volume which arose from changes from the liquid to the solid state, changes in temperature, changes in composition, or changes in aging resulted in the development of stresses. The magnitude of these stresses was dependent on the moduli of elasticity, the flow, the ratio of the coefficients of thermal expansion of the adhesive and adherend, and the topography of the adherend surface. The strength of any particular system is thus dependent on the nature of the adhesive and

August C. Siefert

adherend, the surface characteristics, the physical properties of the components and the design of the joint.

A diagram was given to show the interrelations among the various factors involved in adhesive bonds. The factors discussed by various authors who have written on the theory or nature of adhesion can be placed in proper perspective by means of the diagram given. Each idea advanced to date was concerned with those properties of most importance in the particular system studied. This may account for the lack of universal acceptance of any one author's theory of adhesion.

The next paper, "Theories for the Adherence of Vitreous Enamels to Metals," was by Dwight G. Moore, National Bureau of Standards. Mr. Moore reviewed the various theories for explaining the adherence of porcelain enamels to steel. With iron or steel, adhesion becomes more critical and difficult. First improvements were made by adding cobalt, nickel, etc., to the ground coat. The mechanical gripping dendrites, electrolytic plating, oxide layer, chemical bond, hydrogen blanket theories are all attempts to explain the mechanism of adherence.

The "adherence index" has recently been developed at the Bureau of Standards. This has been accomplished by deforming the vitreous enameled coated metal and then measuring the amount of surface contact to the metal by means of multiple needle contacts. This contact gave a measure of roughness of the deformed surface and indirectly measured the ability of the glass to adhere to the metal.

The results were expressed in a variety of ways, and results showing the effect of the amount of cobalt in the ground coat indicated poor adherence with no cobalt and improved effects with increase in the cobalt content.

Other factors such as nickel-dipping, weight application of the enamel, sandblasting and copper oxide additions to the iron base were all investigated. The general results tend to support the electrolytic theory of Dietzel. The effects of cobalt oxide and CuO have been shown to improve adherence of enamels to stainless steel.

The next paper, "Structural Aspects of the Metal-Glass Colored T.V. Bulb," was written and presented by Arnold S. Rose, I-T-E Circuit Breaker Company.

The 21″ round color television bulb is fabricated by sealing a soft glass plate and neck funnel to an AISI Type 430 (modified) stainless steel envelope which is manufactured by mechanical spinning and forming techniques. Control of the thermal expansion characteristics of the components is made possible by a relatively simple fusion test. The sealing procedures were given, and emphasis placed on the precise mechanical control which is maintained over the critical factor of seal contour.

An analysis was given for the glass strains as determined by quantitative polariscope and strain-gauge measurement. The thermal treatment given the bulb components after sealing was discussed with respect to the strain distribution under pressure loading. It was shown that the control of the glass strain is essential to successful further processing in tube making.

After these observations, the properties of a round low carbon steel bulb and of a 22″ rectangular color bulb were analyzed. An analysis was given for the glass strains as determined by polariscope and strain-gauge measurements. The characteristics of the bulb under pressure loading were similarly presented.

The next paper, "Solder Glass Sealing," was by R. H. Dalton, Corning Glass Works. Mr. Dalton described the use of "solder" glasses which make possible the sealing of ordinary glasses similar to the technique employed with metals. One of the chief requirements of a "solder" glass is fusibility, plus good workability in the neighborhood of its annealing point. The coefficient of expansion is likewise important and should as a rule be lower than that of the parent glass.

Glasses taken from the high lead region of the system PbO-B_2O_3-Al_2O_3-SiO_2 were described as quite desirable. The effects of adding ZnO in small amounts to these glasses was beneficial. "Solder" glasses are likely to possess poor durability and have a tendency to devitrify. The glasses developed covered a considerable range of compositions, but the following glass composition is typical: PbO—72%, B_2O_3—18%, SiO_2—2.5%, Al_2O_3—2.5%, and ZnO—5.0%. The technique of applying the "solder" glass in various types of seals was described.

The paper, "Properties of Some Low Temperature Solder Glasses," was by John Gallup and A. G. Dingwall, Radio Corporation of America. Mr. Dingwall presented a very practical paper in which the use of some low-temperature-softening "solder" glasses in electron tubes was described. In general, these seals are employed for vacuum type seals to be used over a wide temperature range. The parts have to be prepared prior to sealing, and "solder" glass is applied in the form of a dry powder, paste or stick form. Time requirements for heating vary from 1-30 minutes.

Applications for transducers, mica windows, films for metal rims and double windows were shown. Such properties as viscosity, thermal expansion, index of refraction, density, solubility and weather-resistance were presented for the glasses considered.

The following paper was "Trends in Design of Ceramic-to-Metal Seals for Magnetrons" by Leo J. Cronin, Raytheon Manufacturing Company. Mr. Cronin introduced the subject of ceramic-to-metal seals for magnetrons. The change from glass-to-glass bonded ceramics to the present-day all-ceramics-metal seal was pointed out. The mechanism of bonding was described, and the effect of heat treatment on the stress-strain relationship was discussed.

The effects of seal-design and ceramic body composition were covered in detail. The mechanism of bond was also discussed. Actual sizes and shapes of the various applications were described.

The next paper, "Applications of Ceramics to Vacuum Tubes," was by R. E. Manfredi and H. J. Nolte, General Electric Company. It was presented by Dr. Nolte.

The ceramic aspects of sealing were further described and the design and processing of vacuum tubes were treated. Particular emphasis was given to the materials used, as well as a description of the various metal-ceramics structures involved and used.

The following paper in the symposium group was "Active Metal Sealing in Metal-Ceramic Hermetic Terminal Applications" by H. Palmour III, American Lava Corporation.

The active metals of Group IV of the Periodic Chart of Elements have recently received special attention and at present are more readily available. Two of these, titanium and zirconium, have been quite useful in the bonding of metals and ceramic bodies.

Officers of The American Ceramic Society, as installed at the 57th Annual Meeting. Seated, left to right: President Robert Twells, Electric Auto-Lite Company; President-Elect Karl Schwartzwalder, A C Spark Plug Division, General Motors Corp.; Vice President R. S. Bradley, A. P. Green Fire Brick Company. Standing, left to right: Vice President John H. Isenhour, Isenhour Brick and Tile Company; Past-President R. R. Danielson, Metal & Thermit Corp.; Treasurer W. E. Dougherty, The O. Hommel Company; Past-President Ray W. Pafford, Acme Brick Company; Vice President Kenneth C. Lyon, Indiana Glass Company.

One of the remarkable properties of these metals is their greedy desire for oxygen. It is this oxygen-hungry nature of the active metals that accounts for their increasing use in the bonding of metals to ceramic oxides. The oxides of these active metals are in themselves useful ceramic oxides, and there exists a fortunate series of compatible solid solutions, ranging from an active metal alloyed with appropriate brazing metals, through the active metal in a series of solid solutions with its suboxides, and finally to the resulting refractory oxide in solid solution with other ceramic oxides. This, then, provides a means of chemically bonding metals and ceramics.

The desired result is the joining of metal and ceramic components to produce vacuum-tight units with useful electrical and mechanical configurations and with the ability to withstand high temperatures during assembly and operation.

It would seem, in view of its dependable performance and relative economy, that the active metal process will be of major importance in the rapidly expanding technology of metal-ceramic sealing.

The final paper of the symposium, "Application of Ceramic Sections in High Power Pulsed Klystrons," was by Louis H. LaForge, Jr., Stanford University.

Owing to their limited electrical and mechanical properties, glasses have been impractical for r.f. windows with klystron tubes in the Stanford linear accelerators. Several different ceramic bodies in a variety of shapes and sizes have been tried on these klystrons which handle peak powers up to 30 megawatts at microwave frequencies.

High-alumina compositions have proven superior to other formulations for these applications. Until recently metallizing has been performed principally by the moly-manganese process. Currently several techniques are in use, with one basic modification of the moly-manganese method being of broad usability.

The modified moly-manganese system is especially efficacious on materials of high refractoriness, working very well even on sapphire. Suitable brazing materials permit direct soldering of the metallized surfaces without the intervening step of nickel plating or its equivalent.

The next paper presented was "Color Control in the Glass Industry" by A. J. Werner, Corning Glass Works.

Mr. Werner presented some interesting aspects of an important control in the glass industry, namely that related to color. As a rule, each problem of color control in glass manufacturing must be considered as an individual problem. Basically, the control of color is the control of the physical aspects of light transmission at various wavelengths. The usual method of expression is to relate transmission in terms of wavelength, and such curves are useful in describing a product. It is a descriptive system, and with the aid of reference marks, the curves become quite useful.

The use of selected standards, photoelectric colorimetry, GE recording spectrophotometers and C.I.E. chromoticity diagrams were discussed and evaluated in relation to color control. It was also pointed out that color control becomes a problem in colorless glasses as well, and matching, especially in large pieces, assumes great importance.

The first paper in the Glass Division group on Wednesday morning was "Strength of Glass Rods" by R. M. Witucki and Thomas Whalen, Pennsylvania State University. It was presented by Mr. Witucki.

Procedures for drawing glass rods for strength tests were described in detail. After melting in kyanite crucibles, the rods were drawn vertically by means of a porcelain bait and metal chuck up to a height of about 15 ft., controlling the diameter within limits of 2.5 to 3.5 mm. Portions of the rod which had received no mechanical contact either during or after drawing were then tested by application of a bending moment. A soda-lime-silica glass similar to container glasses was used.

Either three-point or four-point loading was applied, using a 2.5 inch span, and increasing the load at a constant rate of 200g./sec. until fracture occurred. Values of breaking stress consistently found were 95,000 p.s.i. using four-point loading at the quarter points, and 186,000 p.s.i. using three-point loading.

In a comparison of strength data on commercial rods and laboratory rods, the latter were consistently stronger. It was believed that the poorer strength of the commercial rods was due to surface scratches developed in handling and shipping. Additional data were obtained on the effects of heat treatment, rate of load application, temperature of drawing and various surface treatments on the glass.

The second paper of the morning sessions was "A Basic Study of the Structure of Hyper-Eutectic Glasses and Their Characteristics: Strength" by R. L. Hess and R. K. Gupta, University of Michigan.

Mr. Hess pointed out that the ultimate strength of glass should be high and equal to that of the molecular bonding. The well-known work of Griffith was reviewed. The observed strength is modified by surface defects, scratches and flaws. The modification of the strength of glass was explained on the basis of a concept of structure described in the paper "A Basic Study of the Structure of Hyper-Eutectic Glasses and Their Characteristics: Structure" by R. L. Hess and R. K. Gupta. This concept was used to explain most of the strength characteristics of glass on the basis of the existence of "potential flaws" in stressed glass.

The next paper, "Flaw Distributions and the Variation of Glass Strength with Dimensions of the Sample," was by C. H. Greene, New York State College of Ceramics at Alfred University.

One of the most important properties of glass is its mechanical strength. However, this property is not as reproducible or controllable as the properties of density, thermal expansion or viscosity. The idea was presented that the strength of glass can be considered as due to a distribution of flaws. The relationship to be expected between straight tension tests and transverse bending tests of samples of varying size was derived for a simple type of flaw distribution function, and the results were correlated with experimental results on acid polished rods.

From these examples it appears that the scatter of results in strength tests may be interpreted in terms of a distribution of flaws on the surface of glass. There is some doubt whether a definite numerical value can be assigned to the theoretical tensile strength of glass. In any case, the practical working strength must be evaluated by measurements on specimens with the same kind of surface and with a surface area under tensile stress of the same order of magnitude as the piece in service.

The following paper, "Modifications of Twyman's Equation and Their Significance," was by Arthur Q. Tool, Takoma Park, Maryland. Mr. Tool pointed out that Twyman's equation for the inelastic deformability of glass is inadequate in many cases. Generally speaking, the deformability of an annealing glass decreases with time as well as with temperature (and not temperature alone).

An Exponential-Integral Equation was developed from Twyman's Equation. This new expression predicates a variation in the deformability with time, and approaches a reasonable degree of adequacy in most practical cases. However, since glass is almost certainly plastic-viscous in nature, no such simple expressions as the above will fully express the exact manner in which an annealing or a disannealing develops. This conclusion may explain the need which Ritland found for modifying the Exponential-Integral Equation.

The next paper, "A Basic Study of the Structure of Hyper-Eutectic Glasses and Their Characteristics: Chemical Durability," by R. L. Hess and R. K. Gupta, University of Michigan, was presented by Mr. Gupta.

Attempts were made to interpret the mechanism of glass deterioration in terms of structure postulated in previous papers. The mechanism recognizes a chemical durability test as a measure of the ability of a reagent to remove X^{+1} type ions from the glass body. The factors which control the X-ion removal are believed to be (1) the composition and thermal history of the glass, and thus its structure; (2) the existence of a primary layer or second medium (usually water) on the glass surface; (3) the availability of hydrogen ions to this primary layer to replace those diffusing into the glass; (4) the availability of either a diffusional or chemical means of removing X^{+1} ions from the primary layer; (5) the temperature as it affects the thermal energies of the X^{+1} and the H^{+1} ions.

The next paper was "Dielectric Losses in Glasses" by Harold T. Smyth, Rutgers University.

Mr. Smyth presented a theory designed to explain the phenomena associated with dielectric behavior of glasses. The theory assumes that a large part of the a.c. dielectric behavior of glasses arises not from the passage of alkali ions from one interstice to another which gives rise to d.c. conductivity but rather jumps from one equilibrium position to another within single interstices. A size distribution of interstices is assumed, and also it is necessary to postulate that the potential barrier between equilibrium positions within one interstice increases with the size of the interstice. It must be assumed too that the potential energy of an ion in a small interstice is lower than for the same ion on a large interstice. Postulation as to the distribution of Li^+, Na^+ and K^+ ions within the interstices was given. It was shown that such a set of assumptions leads to distributions of ions of different sizes in the interstices which may account for the variation of dielectric constant and dielectric losses with frequency and temperature of glasses containing a single alkali or combinations of several alkalies.

The last paper of the morning sessions was "Oxide Glasses, With or Without Silica, for Infrared Applications" by J. M. Florence, F. W. Glaze and M. H. Black, National Bureau of Standards. Mr. Glaze reported some work carried out at the National Bureau of Standards on glasses containing little or *no* silica. These glasses contained Al_2O_3 and CaO as the glass-former. The range of compositions covered is as follows: CaO, 26.7 to 52.0 per cent; Al_2O_3, 28.9 to 49.6 per cent; BaO, 0 to 21.8 per cent; Bi_2O_3, 0 to 25.9 per cent; PbO, 0 to 13.0 per cent; SiO_2, 0 to 6.8 per cent; BeO, 0 to 10.0 per cent; MgO, 0 to 5.0 per cent; and La_2O_3, 0 to 5.0 per cent.

These glasses were proved to devitrify and also were characterized by prominent water absorption band. The latter tendency can be offset somewhat by means of a dry-air treatment. Germanium dioxide is a good glass-former and, when substituted for silica, mole for mole, gave increased infrared transparency.

The first paper in the afternoon session was "Surface Tension, Density, Viscosity and Electrical Resistivity of Binary Alkaline-Earth Borates Containing Three Mole Percent of Potassium Oxide" by Leo Shartsis, L. W. Coughanour, and H. F. Shermer, National Bureau of Standards. It was presented by Mr. Shermer.

The physical-property data on some unusual glasses were presented. The glasses were alkaline-earth borate glasses, each containing three mole per cent of potassium oxide. The addition of potassium oxide was desirable in order to overcome the normal immiscibility of these glasses. A previous investigation of the physical properties of similar alkaline-earth borates was limited by the formation of a two-immiscible-liquid region at low alkaline-earth oxide concentrations. The properties of this new series of glasses

(*Continued on page* 332)

Basic Refractories In The Glass Industry

By JAMES C. HICKS, DIRECTOR, REFRACTORIES RESEARCH
Kaiser Aluminum & Chemical Corporation, Oakland, California

● SERVICE IN glass furnace regenerators has confirmed early laboratory indications that high magnesia periclase refractory brick, particularly 95% MgO brick, offers marked advantages by their important contribution to increased furnace efficiency and service life.

Sizable installations of the periclase bricks in regenerators were first made about 10 years ago. The service of the first trials was on the order of 18 months and since then campaigns lasting three years have proven successful and four-year campaigns are now considered to be quite feasible when the balance of the furnace permits. In no cases to date have the periclase checker brick been the factor causing furnace shutdown.

The early installations were relatively shallow and limited generally to the top dozen courses. It was found in these earlier trials that plugging of the checker flues started in the fireclay section beneath the basic brick. Consequently, in replacing checkers, it was decided in many cases to go lower with periclase brick.

In one furnace where the depth of the periclase section was increased over that in the previous two-year campaign, the run extended to three years and the efficiency of the furnace was increased considerably and maintained throughout the campaign, avoiding the customary decrease in fuel efficiency with age of furnace. In this particular furnace there was no plugging of the checkers, and the customary drop in fuel efficiency toward the end of the campaign did not materialize. The 95% MgO refractories have also been used successfully in regenerator sidewalls and in port sidewalls and arches.

One advantage of the high purity refractories which has become apparent in the study of checker installations at the end of their campaigns is that the brick surfaces remain "dry," with the possible exception of the first one or two courses. This means that the sidewalls of the checker flues do not entrap the carry-over dusts and build up rough deposits. Heat transfer from gas to brick and flow of gas through the checkers are correspondingly improved.

Observation of the used checker settings suggests that smaller flue openings might be employed. Since the flues remain open, it might be possible to employ a 4½-inch square flue, for example, and thereby gain increased volume of heat exchange media.

Fig. 1. Magnesium silicate refractory before testing.

Fig. 2. Magnesium silicate refractory after testing.

The problem of recovering part of the heat carried by waste furnace gases in order to achieve reasonable fuel efficiencies—which is faced by all operators of high temperature melting furnaces—is particularly complex in the glass industry because of the corrosive nature of the dusts and vapors carried by the gases. The question of resistance to chemical attack alone is a thorny problem because the materials carried from the glass batch by the exhaust gases tend to flux refractories of either acid or basic type.

Fireclay regenerator walls and checkers have been used almost exclusively until fairly recent years, but it is now generally recognized that as production rates are raised and temperatures increase, a point is reached at which fireclay regenerators become the factor determining the length of a furnace campaign.

Reaction between the bricks and the carry-over results in the formation of low melting silicate materials which are liquid at the temperatures of the upper regenerator levels, and which therefore drain away and freeze into icicles and stalactites lower down, eventually completely plugging the regenerator setting. This may not happen before a year of operation has passed, but today campaigns of three or four years are desired.

Attempts have been made to avoid slagging of the checkers by using fireclay bricks of higher alumina content than the normal super-duty quality, but the higher alumina materials have failed because of reaction with soda carried by the flue gases. The resulting formation of nephelite causes successive layers of the bricks to shell off because the new minerals formed by the reaction occupy more space than the old ones. Thus, high alumina materials have not proved satisfactory in this service.

Basic refractories have been used in glass regenerators for many years, and particularly within the last ten years have been gaining increased recognition as the best practical solution to the problem. By "basic refractories" is meant primarily magnesia and magnesium silicate materials. Although other minerals are often used to comprise a part of the structure of a basic brick, these grains are almost universally bonded together by magnesia or magnesia silicates, or both. Magnesium silicate is more resistant to the fluxing action of carry-over than is aluminum silicate, and magnesia is better still.

In general terms, four types of basic bricks are available to be considered for glass regenerator use. In order of decreasing magnesium silicate content they are: magnesium silicate grains bonded by magnesium silicates, a mixture of dead-burned magnesite or seawater periclase and refractory chrome ore grains bonded by magnesium silicate, 90% MgO periclase grains bonded by magnesium silicate, and 95% MgO periclase grains bonded by magnesia.

Prior to introduction of high MgO bricks, laboratory work was conducted to study the effect on various types of basic refractories of the fluxing materials carried over into the regenerator chambers from the glass tank. 9 x 2½ x 1″ slices of basic bricks of the four types mentioned above and of a representative fireclay checker brick were subjected to chemical attack at 2725°F. for 50 hours by 165 grams on each of a molten synthetic carry-over material which approximated the composition of samples obtained from a container glass furnace.

The effect on each of these bricks in regard to chemical attack, expansion and specific heat was studied. The carry-over chosen for this test had approximately the following

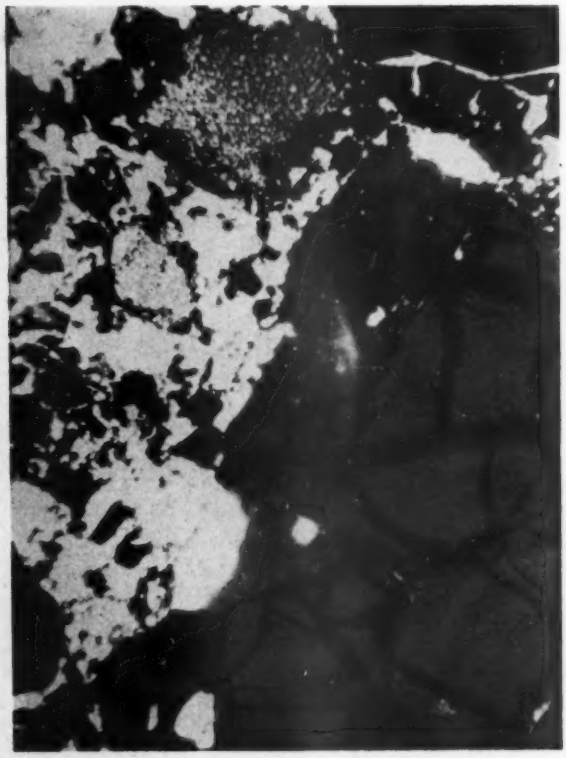


Fig. 3. Magnesite-chrome refractory before testing.

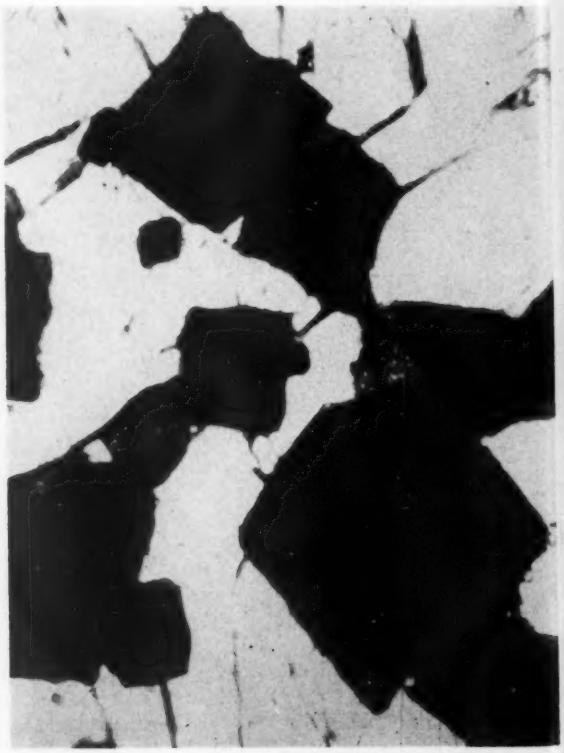


Fig. 4. Magnesite-chrome refractory after testing.

analysis:

SiO	76.0%
Fe_2O_3	0.5
Al_2O_3	8.5
CaO	8.5
Na_2O	6.5

Very briefly, the indications of these bricks were as follows: All of the brick were chemically attacked by the carry-over material to a greater or lesser degree. However, the resistance to the attack was almost in proportion to the magnesia content; that is, approximately 30% of the fireclay sample and about 20% of the magnesium silicate refractory had been dissolved away, and about 10% of the magnesite-chrome refractory was gone. The silicate bonded periclase refractory showed pitting and cracking, but probably less than 5% of erosion, whereas the magnesia-bonded, 95% MgO, refractory showed only slight pitting. Only very slight changes in specific heat were found after the bricks were saturated with carry-over. The earlier work also showed that the product of specific heat and thermal conductivity for the basic brick was almost twice that of the fireclay, and consequently, in view of the fact that the surfaces of the periclase brick remain clean, the thermal efficiency should be much greater and remain higher in service. The magnesite-chrome brick and the silicate-bonded periclase brick grow about two per cent each during the test, the 95% MgO brick grew about one-half per cent, whereas the fireclay and the magnesium silicate bricks showed practically no permanent expansion in this test. The observations of the relative chemical attack are borne out in thin sections of the respective bricks before and after testing.

In the case of the magnesium silicate and the magnesite-chrome bricks, the sections show relatively extensive alterations of the refractories' crystal structure. Figures 1 and 2 show the magnesium silicate refractory before and after testing, as seen under crossed nicols. It will be noted that the corners of the angular grains have been dissolved and rounded by the penetration of liquid silicate material.

Figures 3 and 4 similarly depict the magnesite-chrome refractory before and after testing. In this case the migrating silicate liquids also attack and alter the magnesite grains. Of perhaps greater importance is the very extensive recrystallization of the chromite grains. Attention is directed to the development of euhedral crystals of magnesia-chrome spinel.

Studies of chromite-bearing bricks after service in glass regenerators demonstrate that this is not merely a laboratory curiosity. During the recrystallization of the chromite, a swelling takes place which leads to a very serious weakening, and finally to disruption of the refractory structure. It is for this reason that it is felt that chromite bearing bricks are not to be recommended for glass furnace checkers. They have given generally satisfactory performance in regenerator crowns and sidewalls, where the attack, coming on but one face of the brick, is not as severe.

The effect on high magnesia periclase refractories is shown in Figs. 5 and 6, which are also taken under crossed nicols before and after test. It can be seen that whereas there is some penetration of the crystal structure by silicates from the carry-over, the structure is still dominated by the original configuration in which individual magnesia crystals bear upon one another.

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Fig. 5. High-magnesia periclase refractory before testing.

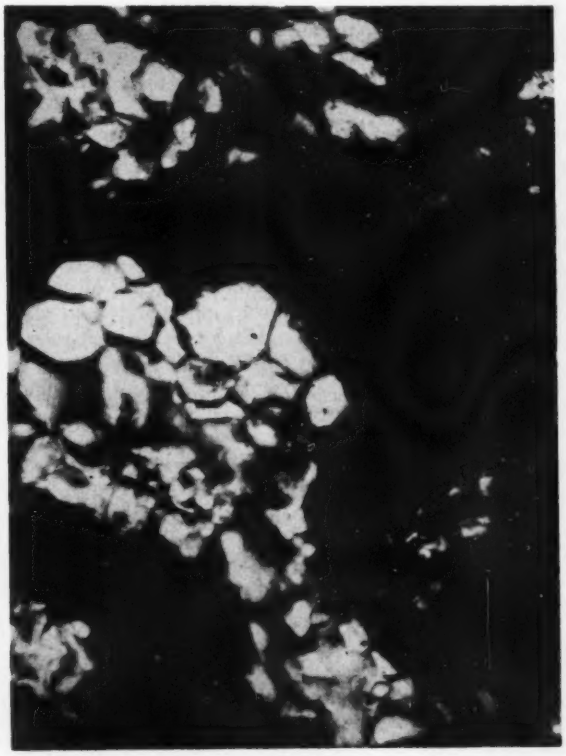


Fig. 6. High-magnesia periclase refractory after testing.

Silicones In The Glass Industry— A Progress Report

By T. J. MAHONEY

Tonawanda Laboratory, Linde Air Products Company,
A Division of Union Carbide and Carbon Corporation, Tonawanda, New York

● DURING THE PAST YEAR, the use of silicones to aid in the production of glassware has received considerable attention. As a result, there are very few production men who have not had the opportunity of examining and working with one or more samples of various silicone products. In tests and production-scale runs, some notable success has been achieved. On the other hand, numerous problems have been discovered, and the basis for further work has been indicated. On the whole, the results of the tests, including production runs, have been gratifying to the point where further development is certainly warranted.

It is believed that a recognition of the promises of silicone materials, placed alongside the problems to be solved, will stimulate further development work. It now seems quite clear that the silicone manufacturer can do only a part of the job by providing new and interesting materials. The glass producer will probably take the leading role in solving the problems of application.

As the first step, we might review what the silicones are and how they function, and then summarize what they have shown and what can be expected of them in the glass industry.

The silicones we are concerned with are members of a family of polymeric chemicals composed of silicone, oxygen, carbon and hydrogen. They are man-made, a product of chemical synthesis, never found in nature. Silicone chemicals are made in a variety of forms, from water-like oils to rigid resinous materials. Consequently, members of the silicone family offer a variety of properties. Those properties that are of most interest to glass manufacturers are thermal stability and excellent release characteristics. For ease of handling, silicones for use in the glass industry are manufactured in the form of aqueous emulsions or water soluble oils and waxes.

Advantages

Used as lubricants for shear blades, chutes, and molds of automatic glass forming machines, silicones promise to: (1) improve mold release; (2) reduce the ever-present danger of flash fires in the glass plant; (3) reduce objectionable smoke, soot and oil vapor; (4) reduce the cost of mold cleaning; (5) improve the appearance of glassware; (6) increase per cent pack and production; (7) reduce cost of spray release agent.

Some of these things have already been accomplished, but additional work must be done to establish the silicones for general usage. As a result of the work during the past year, we are convinced that a great deal will depend on design and proper use of an adequate spraying system. A second factor requiring study is the effect of water hardness. This is not a simple problem because water hardness varies widely from one plant to another.

The first silicone material to find use in the glass industry was an aqueous emulsion of dimethyl silicone oil. The stock emulsion, containing 35 per cent dimethyl silicone oil, was diluted with 50 to 100 parts water and used as a lubricant for blanks and molds. Production runs were made on Hartford-Empire IS Machines—Blow and Blow. Some of the results were as follows.

Test Results

Shear Blades. After a 14-day continuous run, very little build-up was noticed on the surface of blades directly behind and around the cutting edges when compared to that resulting from the use of petroleum based products. This build-up was easily removed by wiping with a cloth. These results show definite advantages in the elimination of much of the time lost in cleaning and also in lost production from shear marks appearing in the finished ware.

Chutes and Scoops. Upon application of the silicone emulsion to lubricate delivery equipment, gob speed on chutes and scoops has generally been observed as maintained or increased. Heat involved was not so great as to cause any breakdown of the silicone. A clear, slippery film on the surfaces was observed. This is in contrast to the residual carbon deposits formed from petroleum lubricants which cause a slowdown of the hot gob and the possibility of glass sticking to the equipment. Thus, time-consuming cleaning is again kept to a minimum, and score marks on the hot gob largely eliminated. It might be mentioned here that it is in the delivery equipment that most of the variable effects of water hardness are observed.

Unless precautions are taken, some scale can result from water hardness. Use of inhibitors and water softeners has met with some success in overcoming this particular difficulty, although no generalization is possible because of variations in water analysis from plant to plant.

Blank Molds. The initial goal of the silicone as a lubricant is the elimination of smoke, soot and vapors, which, in turn, will cut down mold cleaning and improve appearance of ware. The rapid decomposition of petroleum oils at temperatures of 800 to 1200°F., producing black deposits, contrasts quite markedly with the almost negligible decomposition of silicones.

Presented before the Fifteenth Conference on Glass Problems, Ohio State University, Columbus, Ohio.

Application Details

The introduction of dimethyl silicone oil emulsions, like the introduction of fire polishing, has not been without problems. Any new material or process is made practical only after sustained efforts on the part of those to whom its use is advantageous. The first attempts to spray blanks with this emulsion ended in failure. Today, we know that this failure was due to the use of an emulsion that contained too high a concentration of silicone oil. Successful application was achieved when the dimethyl silicone concentration was held below 0.5 per cent.

The transition from an oil- to water-based lubricant also presented problems. The water-based material is a much more efficient coolant than the petroleum oils. Hence, blanks run cooler. In the early stages, in those cases where lubricity seemed to be insufficient, the tendency was to increase the amount of material sprayed on the blank. This led to excessive local cooling, and the ware was checked. The first remedy for this condition was adjustment of the temperature of the blank by decreasing the wind or increasing the rate of production to compensate for additional cooling. Refinements in the method of application through the use of improved spraying devices help to solve this problem, as well as to make possible a better coating of the blank mold.

Consideration must be given to the problems of build-up of residues on equipment, and corrosion of equipment by the aqueous system. These may be real problems. However, they are not unsurmountable. Laboratory investigation has shed much light on the factors which influence these undesirable situations. Control of conditions as to quantity of material applied and manner of application can hold build-up to a minimum well below that necessary for efficient production. Salt content of the dilution water is the controlling factor in corrosion. Suitable inhibitors are sufficient to eliminate corrosion under normal conditions, a fact that has been demonstrated by many months of production. In cases where the quantity or type of salts present cause the water to be extremely corrosive, other steps must be taken. Laboratory work is continuing to pinpoint the sources of difficulty in such cases and to find means of eliminating them.

Surface Lubricity

Progressing from the machine into the lehr, silicones are being used to impart surface lubricity to glassware. The silicones have properties that are useful in deterring abrasion, and thus in reducing breakage, while at the same time giving side effects which may be useful to the manufacturer. Application is made in the lehr to make use of available heat. This in turn aids in obtaining the best utilization of the silicone. The materials are applied from water systems.

Three types of essentially non-methyl silicones have found application as surface lubricants. One is an emulsion of a resinous silicone that has a limited reactivity. The second is a water solution of a waxy silicone material of the oil type. The third type, and one that has some useful properties, is also included in the following table to show representative results obtained.

Properties of Linde Container-Coating Silicones

Silicones Product	*Permanence*	*Water Repellency*	*Lubricity*
Emulsion of Reactive Resin (Linde XE-10 Silicone Emulsion)	Good	Good	Good
Water-soluble Silicone Wax (Linde X-521 Silicone Wax)	Fair	Fair	Excellent
Water-soluble Silane (Linde X-172 Silane)	Excellent	Excellent	Fair

Summarizing this work, the resinous silicone has applications primarily where durable lubricity is the aim, while imparting some water repellency as a side effect. The waxy silicone sacrifices something in permanence, but gives the best lubricity. The silane material is, of course, useful when water repellency is the prime objective, although some lubricity also results. In any case, the silicones are more permanent to washing, alkaline cleaning or steam sterilization than non-silicones.

Silicones have been applied by spray methods in the lehr to confer surface lubricity. Large scale tests are continuing to determine the value of such factors as the extent of the relationship between lubricity and glass breakage, as well as customer acceptance of silicone-treated glass. Customer acceptance can be determined best by putting coated containers into the field. Certainly, there are known examples where a durable, water-repellent finish is required on glass containers, a coating obtained with relative ease with silicones.

Summary

This constitutes the progress that has been made to date with silicones in the glass industry. While a number of interesting silicones are already available and have proven their usefulness to the glass manufacturer, additional development work is certainly indicated. We, the silicone manufacturer, have established research and development programs in an effort to solve some of the field problems, as well as to produce new and improved silicone materials. A great contribution is underway from the glass production people themselves. The new silicone products will flow to the industry, but it is the glass plant and its equipment that must provide the basis for the real proving of these new materials. Continued co-operation between the production men and the silicone manufacturer certainly promises to provide the glass industry with products which should improve the production and quality of glassware.

CHAS. TAYLOR APPOINTMENT

The Chas. Taylor Sons Company, a subsidiary of National Lead Company, has announced the appointment of Charles E. Hall as Works Engineer of both their Cincinnati, Ohio, and Taylor, Kentucky, plants.

Mr. Hall graduated from Michigan College of Mining and Technology in 1936 with a degree of Bachelor of Science in Metallurgical Engineering. He joined the National Lead Company as a student trainee in 1936. He was named Assistant Plant Engineer in 1942 and Plant Engineer in 1946.

Inventions and Inventors

Feeding and Forming

Method of Blowing Glass Bottles. Fig. 1. Patent No. 2,693,667. Filed April 10, 1953. Issued November 9, 1954. Two sheets of drawings. William McLaughlin.

Improvements are shown in Fig. 1 for blowing large glass bottles, demijohns and the like. The bottle or demijohn is formed from a parison that is progressively shaped and solidified from the top of the parison downwardly; that is, the neck portion is first shaped by the neck mold 11 (not shown) and is allowed to solidify so that the parison may be manipulated. Secondly, the parison, after being reheated, is partially blown in the blank mold 28, forming the shoulders 31 which are allowed to solidify. After again being reheated without materially softening the formed shoulders 31 or the formed neck, the parison is finally transferred to the blow mold and is blown without materially altering or modifying the formed necks and formed shoulders. It will be found that the use of this method enables large bottles and demijohns to be easily and economically produced.

The patent contains 3 claims and the following references were cited: 500,841, Atterbury, July 4, 1883; 609,704, Ripley, Aug. 23, 1898; 760,150, Richardson, May 17, 1904; 1,080,372, Schiller, Dec. 2, 1913; 2,225,948, Beatty, Dec. 24, 1940; 2,512,781, Stewart, June 27, 1950; 382/31, Australia, Dec. 24, 1931; and 757,536, France, Oct. 16, 1933.

Furnaces

Glass Melting Furnace. Fig. 2. Patent No. 2,692,296. Filed January 4, 1952. Issued October 19, 1954. Six sheets of drawings. Assigned to Owens-Corning Fiberglas Corporation by Gerard De Piolenc and Robert G. Russell.

A glass melting furnace for the continuous production of glass filaments is shown in Fig. 2. It is the principal object of this invention to provide a unit furnace for continuously melting glass filaments in which the quantity of noble metal employed is greatly reduced.

A thin metal melting element 31 is supported in and extends generally horizontally across the melting chamber

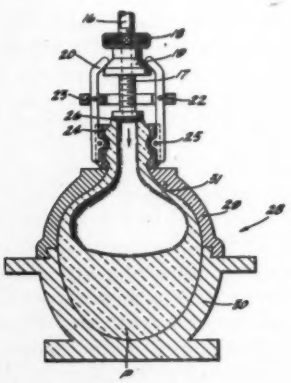


Fig. 1.

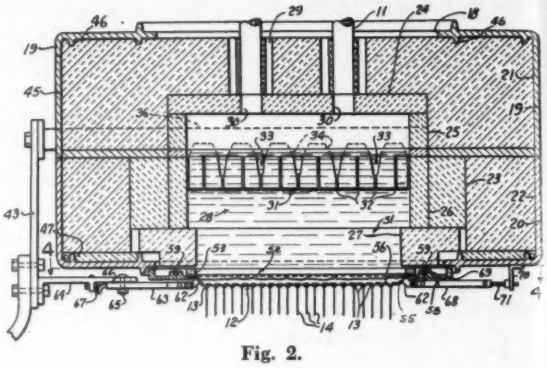


Fig. 2.

28. The element 31 is heated by passing through a high amperage, low voltage current. The heating element 31 lies at a level so that it is entirely submerged in molten and partially melted glass and so that heat can be transferred from both sides of the element 31 to the glass, thus resulting in a high efficiency since the area of both surfaces is employed. The element 31 is also perforated to allow the passage of molten or liquid glass, and to prevent unmelted lumps of cullet, such as marbles or chunks or unfused lumps of batch, from flowing down to the bottom of the melting chamber 28. Molten glass flowing downwardly through the openings 51 and 52 from the glass melting chamber 28 flows into the pan 55 and through the orifices 13 formed in a bottom plate 56 of the pan-like portion 55 of the bushing 12.

The submergence of a heating element extending over practically all of the area of the melting chamber 28 substantially eliminates temperature gradients in the glass pool resulting in more uniform melting and better glass. Because the heating element extends over substantially the entire area of the heating chamber, all the glass flowing through the furnace must pass near the heated element in a thin film which effectively "fines" all the glass.

The patent contains six claims and the following references were cited: 1,928,288, Henry, Sept. 23, 1933; 2,159,361, Atkinson et al., May 23, 1939; 2,165,318, Thomas et al., July 11, 1939; 2,212,528, Slayter, Aug. 27, 1940; 2,314,956, Slayter et al., Mar. 30, 1943; 2,335,135, Staelin, Nov. 23, 1943; and 2,482,299, Stevens, Sept. 20, 1949.

Electrode Assembly for Glass Furnaces. Fig. 3. Patent No. 2,693,498. Filed August 3, 1953. Issued November 2, 1954. One sheet of drawings. Harvey L. Penberthy.

This invention relates to glass furnaces, and more particularly to a novel arrangement for mounting and feeding electrodes into such furnaces. A molybdenum electrode assembly, shown in Fig. 3, is placed in the aperture in the tank block of the furnace and firmly secured by means of the fire brick 32 and cap screw 38. When the glass charge of the furnace becomes molten, a small amount will flow into the space between the bushing 14 and the electrode 15. Because the outer edge of the bushing 14 is at a temperature insufficiently high to maintain

the glass in its molten state, such glass will freeze around the electrode providing an oxidation seal. Because of the clearance allowed between bushing 14 and electrode 15, the electrode may be easily positioned into the furnace upon loosening of set screws 17. A supply of coolant is fed to the feed tube 23 and this coolant is directed against the bushing 14 and electrode 15 at their juncture and any steam formed escapes through the open end of the sleeve 13 along with the heated water. The heated water along with any condensed steam will be received in the funnel 28 from which it is drained. By regulating the setting of the coolant supply valve 27, it is possible to maintain the air-encased portion of the electrode at a temperature below approximately 1000° F. while utilizing only a very small supply of liquid.

When an electrode is substantially fully consumed, as is shown in Fig. 3, electrode replacement may be effected by screwing the male section 41 of a fresh electrode into the threaded female section 39 of the spent electrode whereupon pilot stud 42 will enter the pilot bore 40.

The patent contains nine claims and 12 references were cited.

Glass Melting Furnace. Fig. 4. Patent No. 2,694,272. Filed June 19, 1952. Issued November 16, 1954. One sheet of drawings. Assigned to General Electric Company by Harold H. Spengler.

It has been discovered that the formation of the knots and cords in glass was due to the fact that the partition or shadow wall was attacked chemically by the particles of raw batch material impinging against it and causing the formation of a viscous glasslike mass of foreign material which collected on the face of the partition and ran down into the glass. Contamination of the glass by such foreign material is effected by cooling the vertical surface of the partition to cause the material flowing down the surface to freeze or congeal and thereby be prevented from draining into the glass.

Provision for interrupting the flow of contamination down the face of the shadow wall 6 so as to prevent it from flowing into the molten glass 5 is provided by the metal tubes 12 and 12′ which provide for the circulation of a coolant and which are located adjacent the lower extremity of the shadow wall 6 so that the extremity is cooled to congeal the contaminating material. The metal tubes 12 and 12′, as shown in Fig. 4, each comprise entering and return runs extending from one sidewall of the furnace to the center and are arranged so close to the shadow wall 6 and the adjacent top surface 13 of the bridgewall that the contaminating material 11 must also

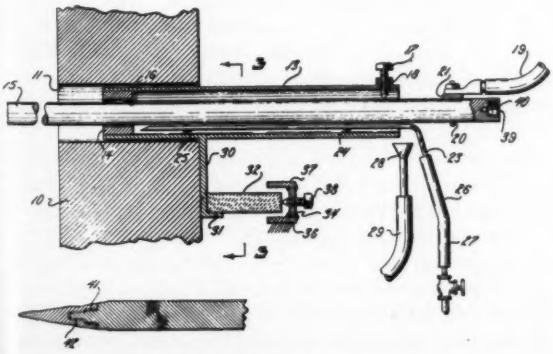


Fig. 3.

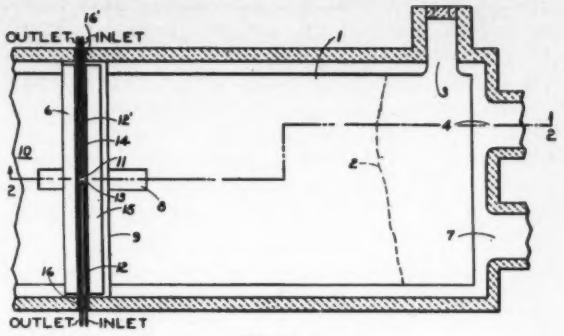


Fig. 4.

contact the tubes 12 and 12′. Accordingly, such contaminating material 11 collects upon tubes 12 and 12′, and can be removed from the furnace along with the tubes 12 and 12′, an operation which is performed periodically when appreciable contaminating material 11 has accumulated.

The patent contains 5 claims and the following references were cited: 2,039,955, Geer, May 5, 1936; 2,203,288, Willetts, June 4, 1940; and 2,284,348, Tharp, May 26, 1942.

Glass Compositions

Glass Compositions. Patent No. 2,693,423. Filed March 23, 1950. Issued November 2, 1954. No drawing. Assigned to Vitreous Research Corporation by Frederick R. Rogers.

This invention relates to glass compositions, and more particularly to castable glasses which are adapted for use in glass-to-metal seals. The primary object is to provide new castable glass compositions having low working temperatures, low coefficients of expansion, and high fluidty at low temperatures. The new glasses have the following compositions:

Class	*A*	*B*	*C*	*D*	*E*
Al_2O_3	11.9	20.7	11.4	10.9	11.1
ZnO	6.3	...	3.9	4.0	10.6
MgO	...	...	...	2.5	...
CaO	9.0	9.3	...	6.2	...
BaO	...	...	2.6	15.7	5.8
SrO	...	...	...	...	...
PbO	...	...	17.8	...	16.1
K_2O	3.5	3.3	2.2	...	...
Na_2O	...	1.2	...	...	...
Li_2O	3.0	3.2	3.5	...	...
B_2O_3	50.4	43.9	43.2	44.9	39.4
SiO_2	16.1	16.7	15.5	15.8	16.9
SnO_2	...	1.7	...	...	...
Coef. Exp. x 10^7	54.6	58.0	60	56	48
Annealing Temp., °C.	503	510	470	590	510
Softening Temp., °C.	641	650	605	735	641

This patent contains 8 claims and the following references were cited: 1,609,329, Taylor, Dec. 7, 1926; 1,736,642, Beaudry, Nov. 19, 1929; 2,030,389, Navias, Feb. 11, 1936; 2,090,098, Berger et al., Aug. 17, 1937; 2,167,482; Hull et al., July 25, 1939; 2,299,750, Hull et al., Oct. 27, 1942; 2,478,626, Grigorieff, Aug. 9, 1949; 2,511,228, Sun et al., June 13, 1950; and Ser. No. 358,067, Herriger (A.P.C.), published May 11, 1943.

Glass Composition. Patent No. 2,692,833. Filed December 17, 1951. Issued October 26, 1954. No drawings. Assigned to Corning Glass Works by William H. Armistead.

Novel glass compositions, possessing characteristics making them suitable for the production of parts utilized in the fabrication of various electrical devices, such as incandescent lamps, electronic discharge tubes and the like, are shown. Glasses which have customarily been utilized for such purposes generally possess a relatively large amount of PbO because of the desirable electrical properties. The following compositions calculated in weight per cent from their respective batches are typical and desirable:

	2	3	4	5
SiO_2	60.6	58.9	60.7	61.5
PbO	13	17	12	14
BaO	9	7	10	8
K_2O	7.9	8.5	8	8
Na_2O	4.7	4	5	4.6
Li_2O	0.8	0.6	0.3	1
Al_2O_3	3	2.5	1.5	1.8
B_2O_3	0.5	1	2	0.6
As_2O_3	0.5	0.5	0.5	0.5

These glasses possess the following characteristic properties:

	New Glass
Melting temperature, °C.[1]	1,165
Working temperature, °C.	983
Softening point, °C.	648
Liquidus temperature, °C.	810
Log_{10} of volume electrical resistivity at 350°	8.0
Log_{10} of volume electrical resistivity at 250°C.	10.1
Thermal expansion cofficient (0-300° C.) X (10^7) per °C.	89

[1]The temperature at which the viscosity of the glass becomes less than 10^3 poises.

The patent contains 1 claim and the following references were cited: 2,018,817, Taylor, Oct. 29, 1935; and 2,562,292, Black et al., July 31, 1951.

Sheet and Plate Glass

Process of and Apparatus for Drawing Glass. Fig. 5.

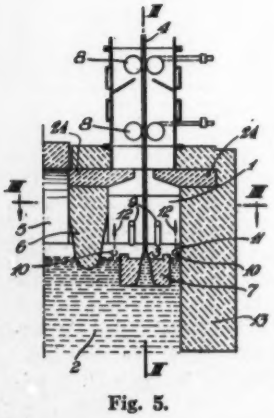


Fig. 5.

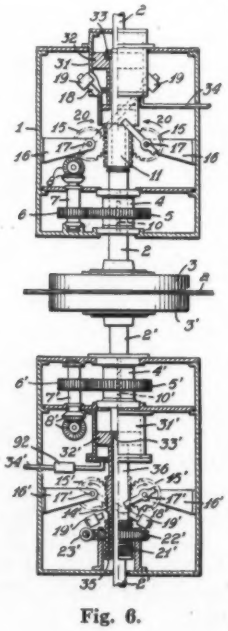


Fig. 6.

Patent No. 2,693,052. Filed August 4, 1949. Issued November 2, 1954. Two sheets of drawings. Assigned to Union des Verreries Mecaniques Belges S. A. by Edgard Brichard.

This invention relates to the drawing of glass in sheet form and is concerned with the provision of a process and an apparatus for producing drawn glass of generally improved appearance. It has been found that any movement of cold air along the still plastic surface of the glass, in the neighborhood of the bulb—that is to say, at the point at which the sheet is formed—produces modifications in the characteristics of the glass, as a result of which the surface of the glass is impaired. A zone of reduced pressure does, however, tend to form at the foot of the drawn glass owing to the fact that the air which is heated in contact rises along the two faces of the sheet. As a result of this, cold air flows towards the bulb on the one hand from the upper part of the drawing chamber, and on the other hand from the outside through the orifices in the chamber. Due to a thermosiphoning effect, the cold air tends to travel towards the bulb and to rise in a thin layer along the sheet which is being drawn, on which it produces harmful effects consisting in particular of striations.

To overcome this disadvantage and to prevent harmful currents of air from being set up in the neighborhood of the bulb, a draught is set up, which balances that which is created by the sheet at high temperature and which draws away from the foot of the sheet the cold currents which tend to travel in the direction thereof. Preferably, use is made of tubes having orifices, through which jets of air under pressure, or of gas, escape upwardly or towards the walls of the chamber at a sufficient distance from the sheet and in such a direction as not to affect the temperature of the sheet.

In the embodiment shown in Fig. 5, there are located in the lower part of the chamber 1, preferably near the level of the bulb, two pipes 10 having closely spaced holes 11 through which the hot or cold air under pressure, or flames, can escape. The pressure inside the pipes 10 must be higher than the surrounding pressure so that the gases escape through the orifices 11 at a certain velocity. The temperature of the gas blown in may be previously raised, or combustible gases may be blown in which are ignited, thus setting up a draft flow of hot gases. The orifices 11 can be replaced by a narrow longitudinal slot which then produces a thin layer of gas instead of a series of closely spaced jets.

The patent contains 10 claims and the following references were cited: 1,816,037, Zellers, July 28, 1931; 2,158,669, Amsler, May 16, 1939; 2,287,136, Rolland et al., June 23, 1942; 2,352, 539, Halbach et al., June 27, 1944; 2,519,457, Halbach et al., Aug. 22, 1950; 2,543,225, Bonjour, Feb. 27, 1951; 144,497, Austria, Jan. 25, 1936; 525,898, Great Britain, Sept. 6, 1940; and 589,950, Great Britain, July 3, 1947.

Method of Simultaneous Grinding and Polishing of Two Faces of Glass. Fig. 6. Patent No. 2,690,034. Filed August 16, 1952. Issued September 28, 1954. Seven sheets of drawings. Edmond Laverdisse.

In carrying into practice the simultaneous grinding and/or polishing of the two faces of a moving continuous sheet or ribbon of glass, it is of major importance to maintain the stability of the working planes of the tools so that they always coincide with the upper face and with

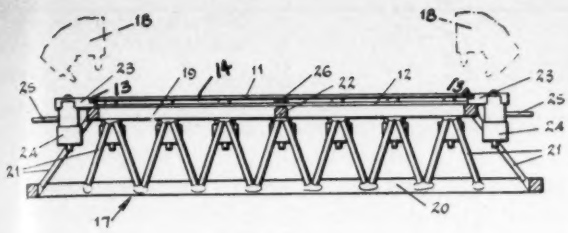


Fig. 7.

the lower face of the glass sheet respectively. The glass sheet rests on members, generally consisting of horizontal rollers, which support and convey it through the grinding or polishing machine. Owing to the wear on the lower tools, the level of their working surfaces is gradually lowered, whereby a deflection of the glass sheet occurs. When the difference in level reaches a certain limit, it is necessary to return the lower tools to their initial level in order to avoid the danger of breakage. In practice, it is preferred to raise these tools slightly beyond the ideal working plane. Such adjustment must nevertheless be repeated approximately every two hours in grinding machines in which an amplitude of wear of 7 cm., for example, can be permitted on an iron of a thickness of 10 cm., before scrapping the tool. The necessity for making these frequent adjustments is avoided when use is made of the invention.

In the constructional form shown in Fig. 6, the arrangement for raising the upper iron is a hydraulic cylinder 31, the piston 32 of which drives the shaft 2 through the ring 33 when the oil under pressure is admitted below the piston through the duct 34 in order to lift the iron 3, the lowering of the iron taking place under the action of its own weight.

The arrangement for pushing the lower iron 3′ comprises a hydraulic cylinder 31′, the piston 32′ of which acts on the shaft 2′ through the ring 33′. In order to avoid a violent thrust on the glass in the event of the upper iron not being in position, an abutment may be provided to limit the upward displacement of the iron 3′. This abutment, which is designated by 35, is situated at the base of the hollow rod 36 of the piston 32′. A pre-adjusting device controlled by screws 21′, 22′, 23′ is disposed at the lower end of the shaft 2′ and the abutment 35 stops against the base of the sleeve 21′ if necessary. In order that the iron 3′ may not fall back in the event of deficient pressure in the duct 34′ for feeding the cylinder 31′, this duct may be provided with a device 92 comprising a non-return valve or ball. The danger of depression of the glass sheet under the thrust of the iron 3 is thus avoided. The reduction in the pressure exerted on the iron in order to allow for the wear may also be obtained by acting on the hydraulic pressure in the cylinder 31′.

The patent contains 18 claims and the following references were cited: 1,705,918, Harrington, Mar. 19, 1929; 1,729,498, Waldron, Sept. 24, 1929; 2,269,197, Hamilton, Jan. 6, 1942; 221,029, Great Britain, Sept. 4, 1924; 455,404, Italy, Mar. 1, 1950; 505,891, Great Britain, May 15, 1939; and 817,793, France, Sept. 10, 1937.

Method of Producing Multiple Sheet Glazing Units. Fig. 7. Patent No. 2,688,824. Filed April 21, 1953. Issued September 14, 1954. Two sheets of drawings. Assigned to Libbey-Owens-Ford Glass Company by Alfred E. Badger and Warren R. Kowalka and John A. Woods.

An improved method is shown for producing hermetically sealed multiple sheet glazing units made entirely of glass. For the purpose of sealing, sheets of glass may be supported on a tray 17 and moved continuously through a furnace (not shown) so that the marginal edge portions of the sheets may be moved past concentrated heat sources in the form of impinging burners. During assembly of the upper and lower sheets 11 and 12 (Fig. 7) in spaced relation upon a suitable edge supporting means, such as the tray 17, and prior to the edge sealing of the sheets, there is placed between the central portions a supporting means, either in the form of a rod 26 or a cup 27 (not shown). In either case, however, the supporting means is of a height corresponding approximately to the spacing between the sheets at the marginally supported edge portions thereof.

Thus, during the edge sealing of the glass sheets 11 and 12, the space between is maintained uniform so that when the unit is sealed entirely and the edge portions 13 have cooled and set, the air space 14 is substantially uniform throughout. After the tray 17 has been moved through the furnace, the central supporting means, in the form of rod 26 or cup 27, may be removed from the central viewing area by means of a magnet. The rod 26 is of a diameter slightly less than that of dehydration hole 15 (not shown) so that it may be drawn from its central supporting position to a position outside the viewing area and beneath the dehydration hole 15 and then lifted bodily from within the air space 14.

The patent contains 12 claims and the following references were cited: 1,124,778, Meuler, Jan. 12, 1915; 1,370,974, Kirlin, Mar. 8, 1921; 1,448,351, Kirlin, Mar. 13, 1923; and 2,389,360, Guyer et al., Nov. 20, 1945.

Testing of Electrically-Conductive Films on Glass Panels and the Like. Patent No. 2,694,180. Filed February 16, 1951. Issued November 9, 1954. Three sheets of drawings (none reproduced). Assigned to Boeing Airplane Company by William K. Bledsoe and John W. Ward.

This invention relates to an improved method for testing the transparent, electrically-conductive microscopically-thin coating on glass panels, such as are now being used in airplane electrically heated windshields, for example. The method involves the measurement not of panel temperature as heretofore, but of temperature difference between corresponding points on opposite sides of a panel. It is found that if substantially all the heat generated or applied at the one surface is stored in the panel, then the temperatures at the point of heat application and the corresponding point on the opposite side of the panel will rise at the same uniform rate and will differ by a constant amount. Only a very short period of time is required for such temperature difference to become substantially constant or stable, depending upon the thermal resistivity and thickness of the panel. The uniformity of the film in all areas of the panel may be determined by first dividing the area of the panel into squares, or other geometric figures of equal area, between the spaced electric terminal zones of the panel. Temperature differences between opposite sides of the sheet are measured, together with the total power going into the film. From the temperature difference measurements, power per unit area is determined by graphic or equivalent mathematical technique and compared with average power per unit area as determined

(*Continued on page* 338)

The Examination of Fusion-Cast Refractory Block by γ-Radiography

Fusion-cast refractory blocks may contain cavities which are formed during the pouring process. These cavities may vary both in size and in position between the two main faces of the block, although their presence is more usual near the "upper" pouring face. If the positions and sizes of the cavities could be ascertained by a non-destructive method, the resulting information could be used to place the block in the most suitable part of the tank.

Such information can be obtained by the means of X-ray photographs, but the use of an X-ray generator for the routine photography of blocks in quantity presents difficulties. Such photography has become practicable, however, through the availability of radioactive elements emitting γ-radiation of great penetrating power. Elements which are used for this kind of work are cobalt-60, tantalum-182 and iridium-192. They have half-lives of 5.3 years, 120 days and 70 days, respectively. The energies of γ-radiation of cobalt-60 (1.17 and 1.33 MeV) are greater than those of the other two. In the photography of refractory blocks, the radiation may be required to penetrate a considerable thickness of material (up to 18 inches or more) and high-energy γ-radiation is therefore to be desired. On this ground and also because of its longer half-life, cobalt-60 is the obvious choice. In addition to γ-rays, it also emits β-particles (0.3 MeV), but these can be absorbed by the metal capsule in which the source is sealed.

Several factors influence the choice of activity of source (i.e., the number of disintegrations occurring in it per second), the chief ones being safety and the desired rate of work.

Safety depends on the size of the chamber used for the work and on the thickness and nature of its walls. If the chamber is already in existence, these factors will automatically impose an upper limit on the permissible activity to insure the safety of both the operator and of persons who may be working immediately outside. These latter must be able to remain there indefinitely without danger.

The ideal rate of work in the present case (reported by Griffith and Price in the April 1954 issue of the *Journal of the Society of Glass Technology*) was that at which on the average blocks are received into the works. However, the number of gammagraphs which can be made during any one exposure depends on the dimensions of the working area, the activity of the source and the allowable degree of distortion, and the practicable rate is, therefore, not necessarily the ideal rate.

This combination of factors led Griffith and Price to the choice of a source having an original activity of 305 millicuries. This source is cylindrical—6mm. long and 6mm. in diameter—and its approximation to a point is thus much less than could be desired. The capsule is attached to the end of a metal rod which is housed in a bomb and it is normally withdrawn into the body of the bomb. The latter is fitted with a lid which when opened allows a cone of radiation to escape from the withdrawn capsule, and this suffices for the taking of a limited number of gammagraphs at one time.

In addition, the rod can be protruded from the bomb by means of a remote control, thus allowing the radiation to escape freely. This can be done with the rod in the vertical position and the articles to be gammagraphed can be conveniently arranged in a circle around it.

The source, in its bomb, is stored and used in a disused brick-built refractory-burning kiln, 30 feet long, 15 feet wide, 7 feet high at the center of the arch, and 3 feet high at the sidewalls. The walls are 2 feet thick. The bomb, when not in use, is kept in a brick storage compartment having walls 18 inches thick and a lid of loose refractory slabs 12 inches thick and located in one corner of the kiln. Just inside the doors of the kiln, there is a baffle wall 18 inches thick, behind which the operator retires when exposing the source.

The blocks to be gammagraphed are arranged on the floor in a circle, at the center of which the source is eventually to be placed, and at such a height that it will be opposite the center of each inward face. A gap is left so that the operator can leave the vicinity of the bomb after the lid has been opened without exposing himself to direct radiation. A dummy source is placed temporarily at the center. A boxwood rule, having a movable crossbar which can be clamped where desired and provided at one end with a hole to go over the dummy vertical rod, is used in placing of the blocks. Some accuracy is desirable in this latter process since uncertainty about the relative positions of course, block and film, considerably reduces the scope of the information subsequently obtainable from the negatives.

A cassette loaded with X-ray film is placed behind each block, one edge of the film being in the plane of the latter's bottom face (i.e., the face of the block which was at the bottom when the block was made). The film, if it is smaller than the cassette, must be accurately positioned inside, and the position of at least one of its edges must be indicated on the outside (the side which is to be in contact with the block). Lead numbers are affixed to the front of the cassette for the purpose of identification of the gammagraph.

The dummy is removed, the bomb put in its place and turned to the vertical position. The remote control is attached, the lid of the bomb is opened and the operator leaves, taking care not to expose any part of his body to the radiation now emerging. He goes behind the baffle-wall, taking the end of the remote control with him, and then, by means of the latter, causes the rod to rise so that the capsule is clear of the bomb. The building is then locked and left for the period of exposure. When the period is over, the procedure is reversed and the cassettes are taken to the dark room for development.

Since the intensity of γ-radiation varies inversely as the square of the distance, and since the densities of

(*Continued on page* 337)

GLASSWARE ASSOCIATION HOLDS TWO-DAY MEETING

During a two-day meeting at Bedford Springs, Pa., the members of the Handmade Division of the American Glassware Association held a panel discussion as a means of getting an objective look at its industry.

The panel members discussed the subject, "Let's Look at the American Handmade Glass Industry." Included on the panel were Mrs. Mary Gillies, Assistant Editor of *McCall's Magazine*; Miss Mary Green, Associate Home Furnishings Editor for *Bride's Magazine*; Frank Rigg, buyer of china and glass for Gimbel's of Pittsburgh; and Walter Browder, Editor of *Crockery and Glass Journal*. The discussion was moderated by John T. Casey, President of John T. Casey and Associations, Inc., the public relations firm which made a recent public relations and merchandising survey in connection with American ware.

In summation, the panel pointed out that handmade glassware is prestige merchandise and particular importance should be directed to American handmade glassware in order that it is properly promoted. The urgency of doing something constructive to educate the public concerning the artistic and prestige values of the American handmade glass was highlighted in individual expressions by all speakers.

Presiding at the two-day meeting, devoted principally to hearing and discussing the findings and recommendations of the Casey report, were W. F. Dalzell, President of the Fostoria Glass Company, and John C. Weber, Jr., Sales Manager of West Virginia Specialties Company. Carl W. Gustkey, Chairman of the Glass House Point Factory Restoration Committee, reported that progress is being made in connection with the joint efforts that are being carried out for the historical factory restoration at Jamestown, Virginia.

"What the Handmade Glassware Industry Can Do to Aid in Case of Total Mobilization" was the subject of a report made by Edward R. Killam, Chief of the Glass Section, Department of Commerce. Mr. Killam also discussed the status of the industry survey for the years of 1953 and 1954 which has been undertaken by the Department of Commerce.

OWENS-ILLINOIS EXHIBITS NEW GLASS BLOCK

Owens-Illinois Glass Company held a three-day exhibition inviting members of the press, including architectural publications, building and contracting publications, local newspapers, etc.

The purpose of the exhibit was to present facts on their new glass block, "Toplite," which is being widely used in schools, homes and other types of buildings.

SELAS CORPORATION BUILDING NEW PLANT

Work has just started on a new $1,000,000 plant for the Selas Corporation of America. The new plant is being constructed on an 11-acre site at Dresher, Pa.

According to the announcement, all research and development activities will be concentrated in a single building specifically designed to provide coordinated laboratory facilities. Production facilities will be arranged for maximum efficiency and versatility in a second building. A third building will house administrative offices.

F. S. Thompson

H. L. Kline

CORHART ELECTS NEW OFFICERS

J. K. Meyer

The Corhart Refractories Company has announced the election of Frederick S. Thompson as Chairman of the Board of Directors and Chief Executive Officer, Hugh L. Kline as President and General Manager, and John K. Meyer as Vice President.

Mr. Thompson has been Manager of Sales, General Manager, Vice President and President of Corhart since joining the firm in 1928. Formerly with General Electric Company, he is a graduate of Defiance College and Case Institute of Technology.

Mr. Kline, who joined Corhart in 1936, became General Manager in 1952 and a Vice President in 1953. He is a graduate of Ohio Wesleyan University.

Joining Corhart in 1934, Mr. Meyer became Plant Engineer in 1936, Works Manager in 1945 and Assistant General Manager in 1950. He is a graduate of Speed Scientific School, University of Louisville.

43RD NATIONAL SAFETY CONGRESS

The 43rd National Safety Congress and Exposition will be held October 17 through 21, 1955, in Chicago, Illinois.

Sessions on industrial safety are scheduled for the Conrad Hilton, Congress, Morrison and LaSalle Hotels; traffic safety sessions at the Congress Hotel; commercial vehicle and transit safety sessions at the LaSalle Hotel; farm and school sessions at the Morrison Hotel; and home safety sessions at the Conrad Hilton Hotel.

BATTELLE DEVELOPS NEW INFRARED-TRANSMITTING GLASS

Glass transmitting a greater range of infrared rays has been developed at Battelle Institute from oxides of antimony. Battelle's antimony oxide glass, which includes oxides of aluminum and the alkali metals as stabilizing agents, will transmit rays of about one-third more of the infrared spectrum than will ordinary glass. Light rays longer than those absorbed by water vapor are also transmitted by the new glass.

Current Statistical Position of Glass

Employment and payrolls: Employment in the glass industry during March 1955 was as follows: *Flat Glass:* A drop of .6 per cent is indicated in the preliminary figure for March of 28,800 when compared with the previous month's 29,000. *Glass and Glassware, Pressed and Blown*: Employment was reported at a preliminary 76,500. This is 1.7 per cent higher than the adjusted February employment of 75,200. *Glass Products Made of Purchased Glass*: March employment remained the same as for February—14,600.

Payrolls in the glass industry during March 1955 were as follows: *Flat Glass*: The preliminary $13,834,080 indicates a drop of .2 per cent from the previous month's adjusted $13,866,060. *Glass and Glassware, Pressed and Blown*: An increase of 2.8 per cent is shown in the preliminary figure of $24,285,690 over the previous month's $23,615,557. *Glass Products Made of Purchased Glass*: The preliminary March figure of $3,891,533 indicates a rise of 1.2 per cent over February's adjusted $3,842,817.

GLASS CONTAINER SHIPMENTS
(All Figures in Gross)

Narrow Neck Containers

	April 1955
Foods	1,052,000
Medicinal & Health Supplies	1,210,000
Chemicals, Household & Industrial	750,000
Beverages, Returnable	859,000
Beverages, Non-returnable	121,000
Beer, Returnable	319,000
Beer, Non-returnable	751,000
Liquors	745,000
Wines	352,000
Toiletries & Cosmetics	701,000
Sub-total (Narrow)	6,860,000

Wide Mouth Containers

Foods	*2,542,000
Dairy Products	195,000
Medicinal & Health Supplies	344,000
Chemicals, Household & Industrial	180,000
Toiletries & Cosmetics	144,000
Packers' Tumblers	157,000
Sub-total (Wide)	3,562,000
Total Domestic	10,422,000
Export Shipments	274,000
TOTAL SHIPMENTS	10,696,000

* This figure includes Fruit Jars and Jelly Glasses.

GLASS CONTAINER PRODUCTION AND INVENTORY
(All Figures in Gross)

		Production April 1955	Stocks April 1955
Foods; Medicinal & Health Supplies; Chemicals, Household & Industrial; Toiletries and Cosmetics	Narrow Neck	4,014,000	4,804,000
	Wide Mouth	*3,523,000	*5,023,000
Dairy Products		190,000	344,000
Beverages, Returnable		848,000	1,421,000
Beverages, Non-returnable		150,000	222,000
Beer, Returnable		336,000	413,000
Beer, Non-returnable		644,000	747,000
Liquors		758,000	899,000
Wines		418,000	478,000
Packers' Tumblers		164,000	170,000
TOTAL		11,045,000	14,521,000

* This figure includes Fruit Jars and Jelly Glasses.

Glass container production, based on figures released by the Bureau of Census, fell off during April 1955 to reach 11,045,000 gross. This is a drop of 2.1 per cent from March's 11,293,000 gross. Glass container production during April 1954 was 10,460,000 gross, which is 5.5 per cent below April this year. Thus far in 1955, glass container manufacturers have produced a total of 42,882,000 gross. This is 4 per cent ahead of the 41,226,000 gross produced during the corresponding 1954 period.

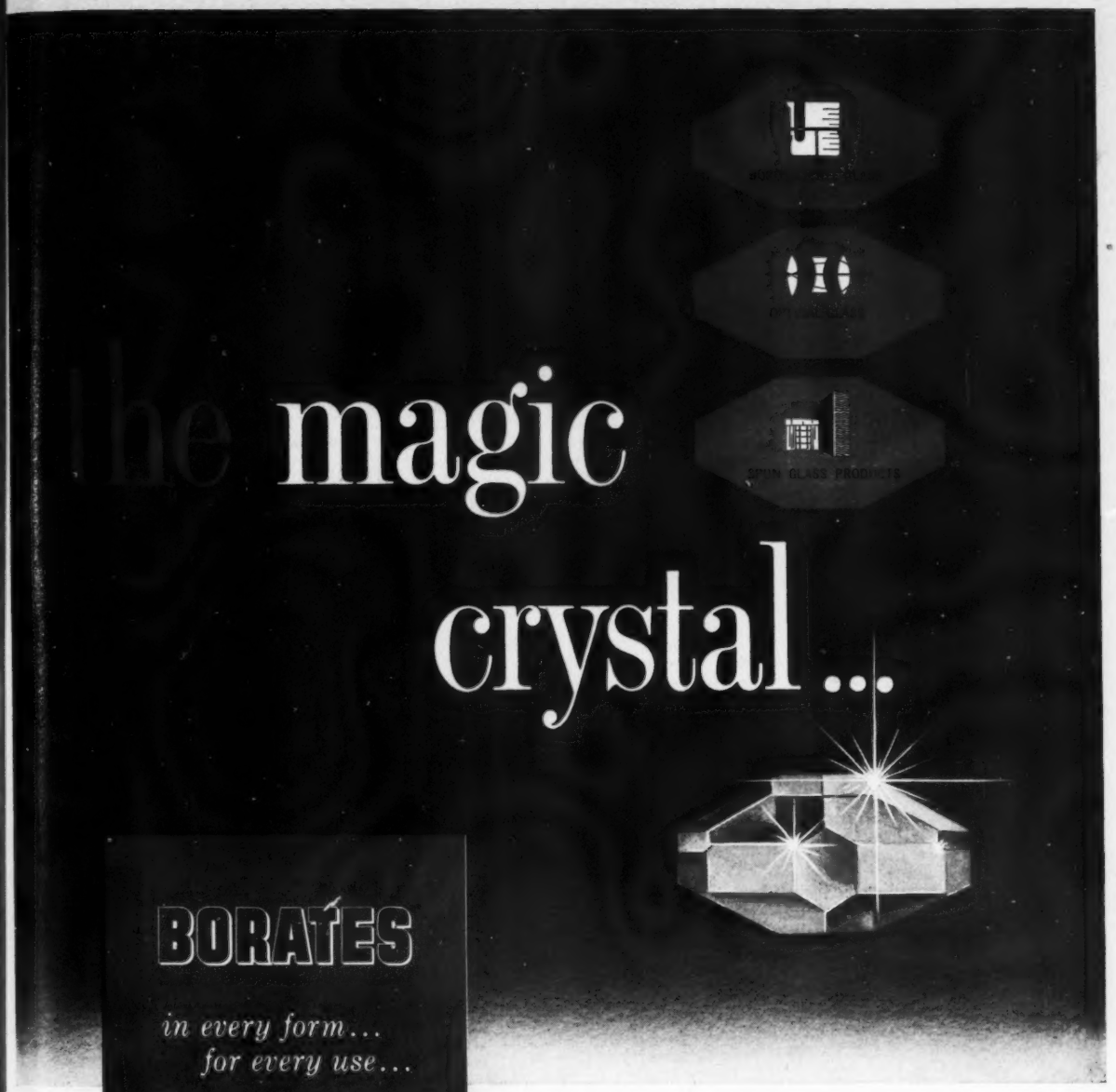
Shipments of glass containers during April 1955 also dropped off and were reported to be 10,696,000 gross. This is 3.8 per cent below March shipments of 11,130,000 gross. During April 1954, shipments were 9,275,000 gross, which is 15.3 per cent under April this year. Total glass container shipments at the end of the first four months of 1955 were 40,869,000 gross. This is 5.2 per cent higher than the 38,829,000 gross shipped during the same period last year.

Stocks on hand at the end of April 1955 were 14,521,000 gross. This is 1.9 per cent higher than the 14,247,000 gross on hand at the end of March 1955 and 10.8 per cent higher than the 13,099,000 gross on hand at the end of April 1954.

Automatic tumbler production during March 1955 was 5,724,878 dozens. This is an increase of 8.9 per cent over the previous month's 5,253,867 dozens. During March 1954, production was 6,067,264 dozens. Shipments during March were 5,619,096 dozens, which is a jump of 19 per cent over the previous month's 4,721,291 dozens. During March 1954, shipments were 5,654,414 dozens. At the end of the 12-month period ending March 1955, production had reached a total of 62,718,119 dozens. This is 3.7 per cent ahead of the corresponding 1954 period when production was 60,474,184 dozens.

Table, kitchen and household glassware: Manufacturers' sales of machine-made table, kitchen and household glassware rose 18 per cent during March 1955 to reach a total of 3,672,086 dozens. This is over the previous month's 3,089,401 dozens. During March 1954, sales were 3,801,773 dozens. At the close of the 12-month period ending March 1955, manufacturers sold a total of 37,759,516 dozens. This is off 1.8 per cent from the 38,464,395 dozens sold during the corresponding period in 1954.

● Russell Brittingham, Vice President of Corning Glass Works, was elected a director-at-large of the Scientific Apparatus Makers Association at its Annual Meeting. He will continue as a member of the executive committee of the Laboratory Apparatus Section of the Association.



Sheer magic in the 17th Century—commonplace today—when magic crystals of BORAX first imparted to glass a desirable resistance to thermal and mechanical shock, and later made possible the well-known Jena Glass. Many centuries earlier, ancient Persia had revolutionized her glazing by means of the selfsame magic crystal. Down through the ages into present-day usage, the four valuable properties of B_2O_3 have benefited the Ceramic and Glass Industry—(1) by improved fluxing of the batch (2) decreased coefficient of expansion (3) increased resistance to corrosion (4) influence on the refractive index. Ask our technical staff how borates may benefit you.

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DIVISION OF BORAX CONSOLIDATED, LIMITED

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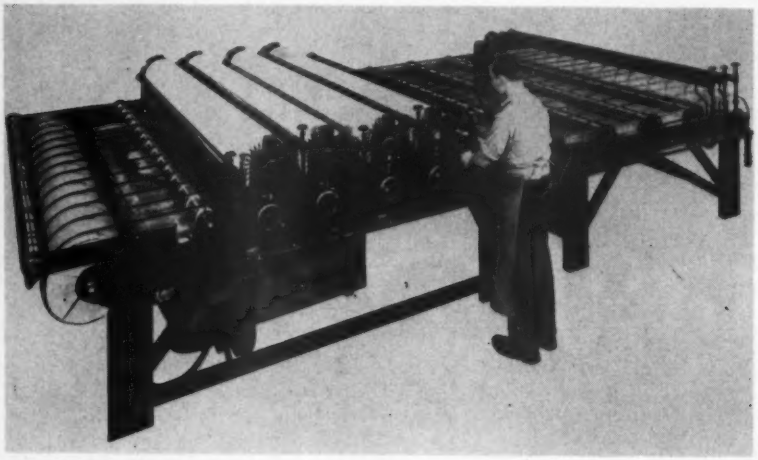
New Equipment and Supplies



MECHANICAL PLATE GLASS WASHER

The Fuller Brush Company, Machine Division, Hartford 2, Conn., has designed and built a mechanical plate glass washer to reduce substantially the number of rejects in the mirror industry and eliminate costly hours of cleaning by hand.

The machine thoroughly scrubs one side of the plate glass and treats the surface chemically to properly prepare it for the silvering operation. It can also be used to scrub one side of any flat plate material to remove thin coatings of oil or loose surface deposits.

Two rotating Fullergript brushes run in a heated detergent which is pumped onto the surface from a tank under the machine and recirculated. A second pair of brushes provides a scrub rinse which removes the detergent and loosened material. Finally, a forced spray of distilled water leaves the glass surface chemically clean. The machine, which has a 9'6" wide by 21' long bed, can scrub material 8' wide at the rate of 12' per minute. It delivers glass automatically onto a conveyor that feeds into the silvering equipment. It requires four 2 h.p. motors for the brush drive and one ⅛ h.p. ratio motor for the feed drive.

B&L MICROSCOPE ACCESSORY

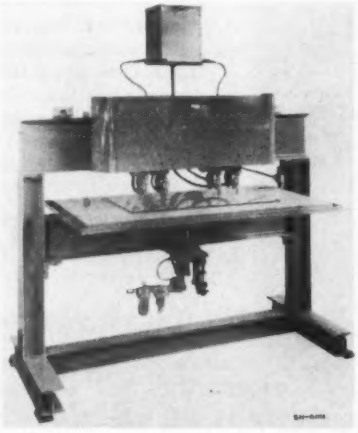
Bausch & Lomb Optical Company, Rochester 2, New York, has introduced a microscope accessory to simplify the measurement of strain in glass and plastics. Known as an accessory slot compensator, the device is for use by manufacturers of glass and plastic containers, and producers of metal-and-glass products such as vacuum tubes.

Determinations of birefringence, correct to plus or minus 2 per cent without calibration, are read directly in millimicrons from a scale engraved on a rotatable drum. No computations or conversion tables are needed and training time is substantially reduced. The instrument performs with greatest efficiency when used with light having a wavelength of 5890 Angstroms. Retardations from 0 to 2700 millimicrons can be measured simply with the B&L compensator. Scale division values engraved on the side of the instrument provide a permanent record and a means of ready reference.

NEW GLASS DRILLING MACHINE

Sommer and Maca Glass Machinery Company, 3600 South Oakley Avenue, Chicago 9, Illinois, has made available a newly engineered 4-spindle automatic glass drilling machine.

The new machine is designed for production drilling of holes in small sizes of glass at close centers (minimum 1 ¼") and is completely automatic. All spindles are quickly and easily adjusted to the hole pattern. The coolant feed to each drill is automatically controlled, and the machine can be furnished with 2, 3 or 4 or more drill spindles. One user reports drilling 300 ¼" holes per hour in plate glass.



GLASS THICKNESS GAUGE

Nife Incorporated, Copiague, Long Island, N. Y., has make available the Nife glass thickness gauge for production line checking in the manufacture of electronic tubes, bottles and glass products of all shapes.

The object to be measured is simply placed over the light on the instrument. The thickness of the glass is seen on a screen as a ribbon of light which is measured by reading the scale. Defects and variations in thickness can easily be seen by turning or moving the object being checked.

Diffraction index is measured by first finding the thickness of a glass sample with a micrometer, then placing the sample on the instrument and adjusting the scale to coincide with the thickness.

SERVOFRAX GLASS

Servo Corporation of America, 2020 Jericho Turnpike, New Hyde Park, New York, has announced Servofrax, an economical, sturdy glass which transmits infrared radiation in the 2 to 12.5 micron wavelength band. Its applications include bolometers, pyrometers, gas analyzers, spectrometers, monochrometers, military projects, as well as temperature control and infrared detection systems.

CATALOGS RECEIVED

Hartford-Empire Company, Emhart Manufacturing Company, 333 Homestead Avenue, Hartford 2, Conn., has published a condensed catalog featuring the complete line of glassmaking machinery produced by Hartford-Empire.

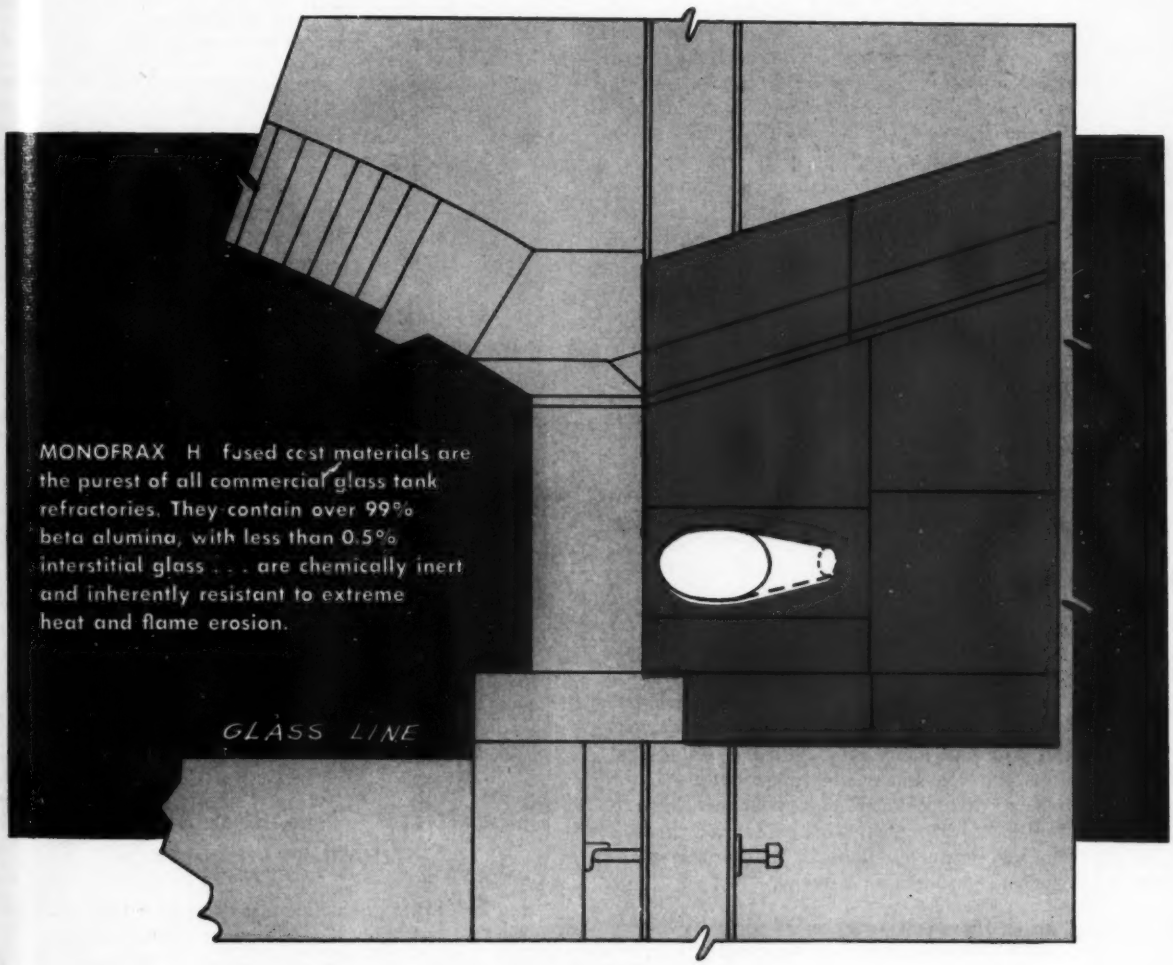
The 40-page illustrated booklet includes specifications for more than 275 machines produced by H-E and three other Emhart divisions: Henry & Write, The V & O Press Company and Standard-Knapp Company.

Diamond Alkali Company, 300 Union Commerce Building, Cleveland 14, Ohio, is now distributing its fourth edition of "The Story of the Chemicals You Live By."

The 24-page newly-revised and enlarged booklet liberally illustrates and discusses the part played by chemicals in everyday life. It discusses these basic materials, their principal applications and their production. Pictorial supplements are devoted to Diamond plants.

Block lining in port neck cuts laying costs . . . eliminates vulnerable joints

Many glass producers recognize the advantages of lining port necks with large blocks of MONOFRAX® H fused cast refractory instead of brick. The large blocks can be laid faster and more economically, and offer fewer joints to be attacked. The MONOFRAX H lining provides far longer life than other refractories because of this material's resistance to high temperatures, heat shock, flame impingement and attack by volatiles—some MONOFRAX H port necks are still in excellent condition after more than 4 years' service. And since MONOFRAX H material does not flake and is almost completely free of glassy phase, it helps reduce refractory-caused stones and cords in the finished ware.


MONOFRAX H fused cast materials are the purest of all commercial glass tank refractories. They contain over 99% beta alumina, with less than 0.5% interstitial glass . . . are chemically inert and inherently resistant to extreme heat and flame erosion.
GLASS LINE

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Dept. L65, Refractories Div., Perth Amboy, N. J.

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G. B. Watkins

D. E. Sharp

L-O-F FORMS TECHNICAL POLICY COMMITTEE

The formation of a permanent Technical Policy Commmittee to strengthen and broaden the entire glass technical operations of Libbey-Owens-Ford Glass Company has been announced by Curtis W. Davis, Executive Vice President in charge of Production. Mr. Davis was recently designated by the Board of Directors to have executive responsibility for manufacturing, technical and industrial relations activities of the company.

Dr. George B. Watkins, for many years Director of Research, has been appointed permanent Chairman of the expanded Committee, and Dr. Donald E. Sharp, formerly head of glass technology, will be permanent Vice Chairman. Other members of the group will include William H. Hasselbach, Vice President-Engineering; R. A. Nyquist, Director of Engineering; E. L. Walters and R. W. Abbott, Associate Directors of Engineering; H. M. Alexander, General Manager of Research and Development; Dr. Joseph D. Ryan, Director of Research; Dr. Roy W. Wampler, Associate Director of Research; R. A. Gaiser, Assistant Director of Research in charge of Glass Films; I. G. Fowler, Director of Development; Frank A. Rodman, Director of Technical Service; and Wilbur F. Brown, in charge of the chemical control department at Rossford plant.

Mr. Davis said it is anticipated that the technical policy group will stimulate new research projects, evaluate all existing projects, check progress and advise various experimental courses of action. He further stated that the committee will coordinate all joint activities of the various divisions of technical and production departments, and all technical reports will be funneled through the committee and pertinent data made immediately available to patent and production personnel.

EXECUTIVE APPOINTMENTS AT GENERAL REFRACTORIES

Drew M. Thorpe has been appointed Executive Vice President of General Refractories Company, according to an announcement by L. Y. Greene, President. He formerly served as a Vice President of the firm.

Other executive appointments were Lee A. Diehle, elected from Assistant Secretary and Assistant Treasurer to Vice President and Controller, and George R. Rittenhouse to Assistant Secretary and Assistant Treasurer, succeeding Mr. Diehl.

PROFESSOR TURNER RECEIVES OTTO SCHOTT MEDAL

The Otto Schott Commemoration Medal was presented to Professor W. E. S. Turner by the Deutsche Glastechnische Gesellschaft at its Annual Meeting in Berlin on May 10.

Its first recipient was the late Professor Gustav Tammann, of Gottingen, in 1930, and Professor Turner will be only the fourth to receive it, and the first non-German.

Professor Turner, like Professor Tammann, became interested in glass as a duty during the first World War. Out of his researches and other activities, there developed a specific sphere of glass technology with a department at the University of Sheffield and a Society of Glass Technology. He was first President of the International Commission on Glass from 1933 to 1953, and is now Honorary President.

KNOX NAMES DIRECTOR OF PERSONNEL AND INDUSTRIAL RELATIONS

The appointment of Harry D. McLaughlin as Director of Personnel and Industrial Relations for the Knox group of companies has been announced by A. W. Wishart, President.

Mr. McLaughlin entered the field of industrial relations in 1934 when he became associated with Corning Glass Works. In 1951, he was named Supervisor of Industrial Relations, Westinghouse Electric Corporation, Electronic Tube Division, continuing in that capacity until June 1953, when he was named Director of Industrial Relations of the Houze Glass Corporation.

MODEL OF O-I PLANT WINS PRIZE

Using the drawing of a glass plant operation that appeared in the Owens-Illinois Glass Company annual report as his guide, 13-year-old Ray Potter, Jr., of Maumee,, Ohio, built this prize-wining model, complete with furnace and bottle forming machines, from discarded tin cans, corrugated boxes and plywood.

Inspecting the details above are Earl E. Smith, left, O-I's Assistant Secretary and Assistant Treasurer, and John H. McNerney, Secretary-Treasurer of the company. The model won a prize at the Annual Science Day sponsored by the Northwestern Ohio District of the Junior Academy of Science.

YOU USE BRICK TO BUILD A BUS

Behind everything that's made or moved lies the refractory brick that contains the flames, the enormous heats, of industry.

Without refractory brick, you'd see no bus in this picture. Nor any picture, for that matter.

Making refractories for the infinite requirements demanded of them is a precise and exacting science, stemming from vast resources of mines, minerals and laboratory control.

And General Refractories provides them from multiple plants and warehouses strategically located to serve industry swiftly . . . dependably . . . economically.

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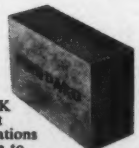
FOR THE GLASS INDUSTRY . . .

RITEX—Unburned basic brick—in magnesite, magnesite-chrome, and chrome-magnesite. More resistant to spalling. Lower porosity, lower thermal conductivity—high hot strength.



GREFCO SILICA BRICK are available at convenient locations from California to Pennsylvania. Glass men know there is no finer product. No more dependable supply.

OLIVE HILL—An exceptionally strong and dense fireclay brick—true to size and shape.

Ground-breaking ceremony for new Armstrong expansion held on May 5.

ARMSTRONG EXPANDS AT MILLVILLE

C. J. Backstrand, President of Armstrong Cork Company, is shown above breaking ground to start construction of a new "cold end" for the company's glass container plant at Millville, New Jersey.

The project, to be completed late next year, will add more than 100,000 square feet of floor space to the 600,000 square feet in the present plant and will provide completely modern facilities for inspection, carton assembly, packing and shipping operations.

City officials of Millville joined the Armstrong executives in the ground-breaking ceremony. Standing in the angle of the batter boards is W. W. Pedrick, III, Millville Plant Manager. To the right of Mr. Backstrand is Mayor Benjamin Corson, of Millville, and at the extreme right is J. C. Feagley, Vice President and General Manager of Armstrong's Glass and Closure Division. At the left end of the batter boards is George A. Reinhard, Jr., Armstrong's Chief Engineer, and next to him is Roy A. Horning, Production Manager of the Glass and Closure Division.

• All thermometers and hydrometers manufactured by Kimble Glass Company, subsidiary of Owens-Illinois Glass Company, will be trademarked Exax.

Glassmakers Prefer

SOLVAY **Potassium Carbonate**

Because...

...It's the ONE Potassium Carbonate That is

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• UNIFORM IN GRANULAR SIZE!

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DUSTLESS CALCINED IS 99-100% K_2CO_3

GRANULAR HYDRATED IS 83-85% K_2CO_3

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Sodium Bicarbonate • Ammonium Bicarbonate • Caustic Potash • Chloroform
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Mathieson Quality: *everything's under control*

Prerequisite to quality chemicals is a control procedure that keeps close tab on the product stream as it flows through the plant. Pressures, temperatures, and rates of flow must be maintained within strict limits to assure chemicals that meet top specifications. The control room above helps safeguard the consistent high quality that is typical of *all* Mathieson chemicals.

In addition to quality, there are other considerations of interest to all buyers of chemicals. For example, the protection of multi-plant production facilities . . . 3 major alkali plants, 7 sulphuric acid plants, 6 caustic soda plants, 5 chlorine plants, 3 ammonia plants . . . as well as practical technical assistance with chemical handling and application problems.

Call on us when planning your chemical requirements. Perhaps you can buy to better advantage from one of America's largest producers of basic industrial chemicals.

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INDUSTRIAL CHEMICALS DIVISION • BALTIMORE 3, MD.

MATHIESON

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CAUSTIC SODA • SODA ASH • CHLORINE • SULPHURIC ACID • SULPHUR • AMMONIA • NITRATE OF SODA • BICARBONATE OF SODA • NITRIC ACID • SULPHATE OF ALUMINA • SODIUM CHLORITE PRODUCTS
ETHYLENE OXIDE • ETHYLENE GLYCOL • DIETHYLENE GLYCOL • TRIETHYLENE GLYCOL • POLYGLYCOLS • DICHLORDIETHYLETHER • ETHYLENE DICHLORIDE • METHANOL • SODIUM METHYLATE • ETHYLENE DIAMINE

Glass Division Program • • •

(*Continued from page* 312)

were compared with the limited results of the previous work. The order of surface tension, BaO > SrO > CaO, was preserved. The densities at room and elevated temperatures were of this same order. The reverse order was noted for the viscosity data. The electrical resistivity data gave no well defined order and varied with both temperature and concentration.

The second paper of the afternoon was "Far Ultraviolet Spectra of Various Minerals and Glasses" by R. B. Klevens, Mellon Institute of Industrial Research.

Previous work on the determination of the spectra of various minerals and glasses in the far-ultraviolet region was continued. The extension of spectroscopic measurements into the far ultraviolet with a fluorite prism apparatus makes possible studies in the 1250 a.u.-2300 a.u. range. A simple photographic instrument and various more recent modifications, which make possible the automatic recording of these spectra, were described. Preliminary studies on various minerals and glasses show definite spectra which could possibly be associated with various contaminants or additives or with varying degrees of disorder within the samples. The GE apparatus used was greatly improved by the use of xenon, krypton, and argon as a light source. Pile-irradiated sapphire, quartz and spinel indicated varying degrees of disorder. The work was prompted by the recent interest in color centers.

The next paper was "Luminous Flux Transfer in Glass by a Network Method" by Philip F. O'Brien, University of California. It was presented by Neill Brandt in the absence of Mr. O'Brien.

The spectral reflectance and transmittance of luminous flux through glass plates may be represented by a network of resistances with values fixed by the relative geometry and the reflectances while the initial driving potential is related to the transmittance. All inter-reflections are represented in the construction of the network.

The total reflectance and transmittance of absorbing plates in series may be computed by the circuit method when the plates exhibit reflectances that are different according to the side viewed. For example, an evaporated metal film on a glass plate may reflect 25 per cent when viewed on the exposed side but may reflect less than 10 per cent when viewed through the supporting glass plate. The transmittance of such a glass-metal film system must be the same in both directions as required by the Second Law of Thermodynamics.

A network which allows the prediction of the total reflectance and transmittance of a glass plate for diffused flux transfer was constructed and solved for a range of refractive indices to illustrate the method. Chromaticity changes associated with inter-reflections in colored glass systems, such as glazed wall tile, may be predicted by a network which can be solved by the methods of circuit analysis or by the use of an analogue computer.

The next paper, "The Colors of Platinum, Palladium and Rhodium in Simple Glasses," was by G. E. Rindone and J. E. Rhoads, Pennsylvania State University. It was presented by Mr. Rindone.

Unusual color effects have been noted when glasses have been melted in platinum and also where platinum has been used as an electrode in electrical melting. In order to study such color effects, variations were noted when the chlorides of platinum, palladium and rhodium were added to simple alkali silicate, borate and phosphate glasses.

Yellow, pinkish yellow, orange and brown colors, in addition to aventurines and grays, were observed in the various glasses. Platinum exhibits an anomalous behavior in phosphate glasses. Small additions of platinum chloride produce gray colors while larger amounts produce yellow and orange colors. Nucleation by platinum crystals leading to devitrification was observed in some phosphate glasses.

The next paper, "The Production of Color Centers by X-Rays in Rather Pure Fused Silica, Part II," was by Alvin J. Cohen, Mellon Institute of Industrial Research. Mr. Cohen presented results that were a continuation of work reported at the Fall 1954 Glass Meeting in Pittsburgh.

Color centers are produced in Corning purified fused silica at 214 mu and in certain specimens at both 214 and 260 mu. The color centers in this material were compared with those produced in Amersil fused silica under comparable conditions. The x-irradiation effects in these two silicas are markedly different.

The color centers in the Corning material continued to grow after repeated x-irradiation. There was a trace of Be and Ge in the Amersil that was not present in the Corning purified fused silica. At present, however, it is not known what impurities may be associated with the color centers.

The next paper was "Barium Titanium Silicate Glasses" by E. H. Hamilton and G. W. Cleek, National Bureau of Standards.

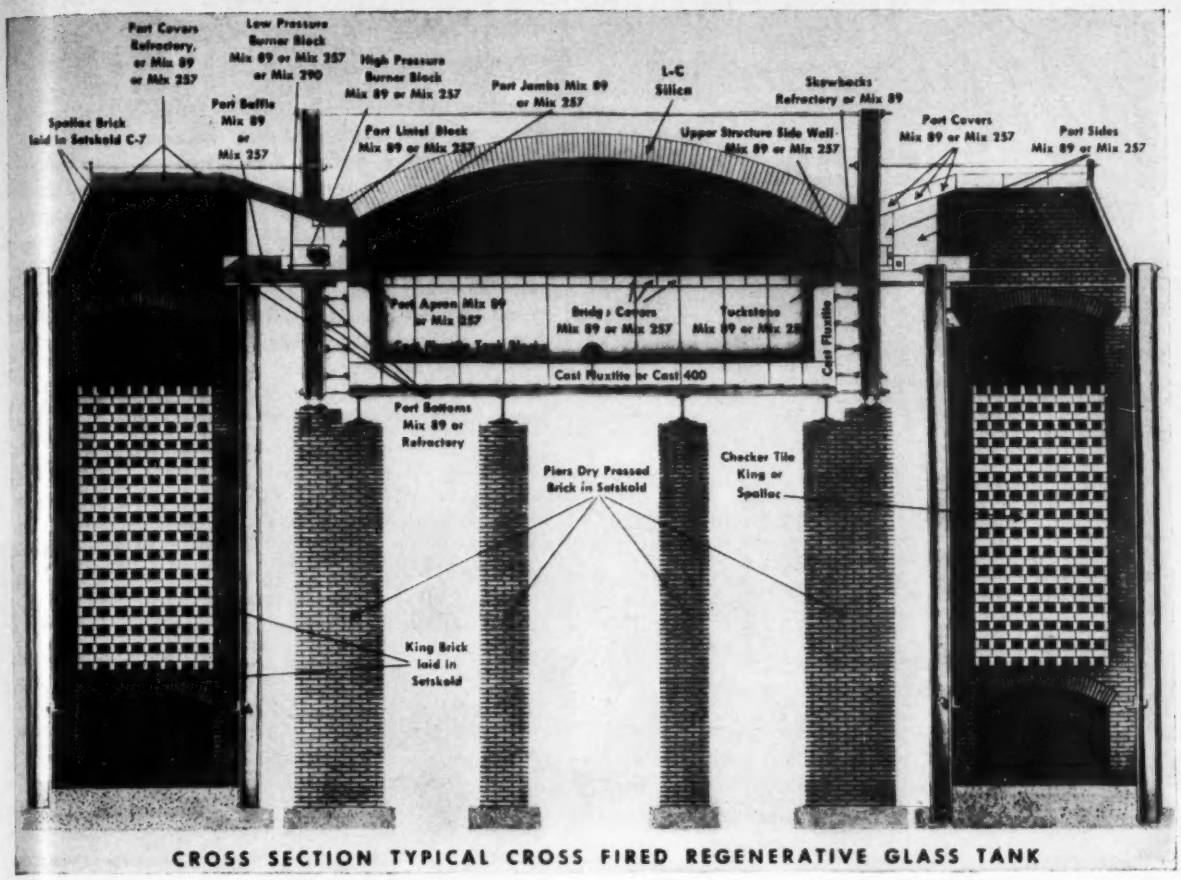
Additional work in the field of special glasses was reported by Mr. Cleek of the National Bureau of Standards. The area of good glass formation in the system BaO-TiO_2-SiO_2 was investigated, and such properties as density, refractive index, liquidus temperature, infrared transmittances, chemical durability and hygroscopicity were determined. Other oxides, such as La_2O_3, ThO_2, ZrO_2, Ta_2O_5 and Nb_2O_5, were introduced into a ternary base glass by substitution for one of the oxide components of the glass on a mole for mole basis.

The better glasses contained approximately: SiO_2—50-60%, BaO—30%, TiO_2—20%, La_2O_3—4-8%. A number of stable glasses, which have high refractive indices (1.70-1.91), good infrared transmittances and high deformation temperatures (about 836° C.), which are resistant to attack by acids and alkalies and also possess lower hygroscopicities than fused silica and Corning 7740, were revealed.

The last paper in the afternoon session was "Antimony Oxide Glasses" by W. A. Hedden and B. W. King, Battelle Memorial Institute.

Mr. Hedden reported results concerned with glasses containing a high content of antimony oxide. Good glasses in the system Na_2O—Al_2O_3—Sb_2O_3 were noted in the following approximate range of composition; Na_2O—12-17%, Al_2O_3—10-18% and Sb_2O_3—70-80%. Potash (K_2O) was also found to aid the transparency of the glasses. In melting, sodium nitrate was recommended as being helpful in stabilizing the Sb_2O_3. Transparent glasses, in which antimony oxide was the only glass-forming material, were found to transmit infrared rays in wavelengths up to 6.2

(*Continued on page* 334)


Port Covers Refractory, or Mix 89 or Mix 257
Low Pressure Burner Block Mix 89 or Mix 257 or Mix 290
High Pressure Burner Block Mix 89 or Mix 257
Port Jambs Mix 89 or Mix 257
L-C Silica
Skewbacks Refractory or Mix 89
Port Covers Mix 89 or Mix 257
Port Sides Mix 89 or Mix 257
Spallac Brick laid in Setskold C-7
Port Baffle Mix 89 or Mix 257
Port Lintel Block Mix 89 or Mix 257
Upper Structure Side Wall Mix 89 or Mix 257
Port Apron Mix 89 or Mix 257
Bridge Covers Mix 89 or Mix 257
Tuckstone Mix 89 or Mix 257
Cast Fluxite
Cast Fluxite or Cast 400
Port Bottoms Mix 89 or Refractory
Piers Dry Pressed Brick in Setskold
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Laclede-Christy serves you best when you use its *complete service.*

This service includes specialized refractories for tanks, pots, feeder parts, superstructure refractories, as well as silica brick and mortar, fire clay brick, refractory cements and plastic fire brick.

Often you obtain a sizable freight advantage by using Laclede-Christy as your only source of supply. That saves money.

If you need special help, Laclede-Christy provides that too. Laclede's years of experience and close cooperation with all kinds of glass manufacturers makes this help unusually valuable.

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Milestones in Glass Progress

PHOTO COURTESY TOLEDO MUSEUM OF ART

970 One of the earliest uses of stained-glass windows was recorded by Adalberon, Bishop of Reims, France, when rebuilding the cathedral in A.D. 970. During the late Middle Ages, no church was considered complete without them. For an illiterate age, they became sermons in glass. Above is 16th Century example.

1890 Michigan Alkali Company, now a division of Wyandotte Chemicals Corporation (South Plant, above), was founded by Captain J. B. Ford to supply Soda Ash to the glass industry. Wyandotte has grown up with glass. Today, as in the past, it is a working partner, supplying technical assistance and raw-material chemicals to those great companies marking milestones in glass progress.

Wyandotte

CHEMICALS

Wyandotte Chemicals Corporation, Wyandotte, Michigan
Offices in Principal Cities

Founded by a Glassmaker to Serve the Glass Industry

Glass Division Program • • •

(*Continued from page* 332)

microns, but have little ultraviolet transmittance. Other properties were also reported on these unusual glasses.

The following papers were listed as supplementary titles: "Phase Separations in Glasses Containing Sulphates" by G. E. Rindone, Pennsylvania State University; "The Brookfield Synchroelectric Viscometer for Measurement of Glass Viscosity" by G. R. Machlan, Owens-Corning Fiberglas Corporation; "Anomalous Properties of Some Titania-Containing Glasses" by Bh. V. Janakirama-Rao, International Resistance Company; "Proposed Theory for the Potash-Silica-Titania Glass System" by W. E. Hauth, Jr. and Bh. V. Janakirama-Rao, International Resistance Company; "Formation of Color Centers in Glasses Exposed to Gamma Radiation" by N. J. Kreidl and J. R. Hensler, Bausch & Lomb Optical Company.

At the business meeting held at the close of the technical sessions on Monday, the Fall Glass Meeting was announced for September 15 and 16, 1955, at Bedford Springs Hotel, Bedford Springs, Pennsylvania.

Newly elected officers for the Division were as follows: *Trustee*, O. G. Burch, Owens-Illinois Glass Company; *Chairman*, A. C. Siefert, Owens-Corning Fiberglas Corporation; *Vice-Chairman*, J. Earle Duncan, Pittsburgh Plate Glass Company; *Secretary*, F. V. Tooley, University of Illinois; *Counsellor*, F. C. Flint, Hazel-Atlas Glass Company.

The following Program Committee was elected for the year: *Chairman*, John W. Michener, Owens-Corning Fiberglas Corporation; F. R. Bacon, Owens-Illinois Glass Company; O. L. Anderson, Bell Telephone Laboratories.

An "International Congress on Glass" is announced for July, 1956, in Paris, France. It was also announced that copies of the brochure, *Opportunities in Ceramics*, are now available for distribution at the Society office in Columbus. Various committee reports were received, accepted and approved.

This was a most successful meeting in which over two thousand were registered. The Program Committee of the Division is to be congratulated on arranging a very splendid and comprehensive program. The only criticism, if any, was that there were too many papers for the presentation time allowed.

PAUL A. WEBSTER, OF HARTFORD-EMPIRE, DIES

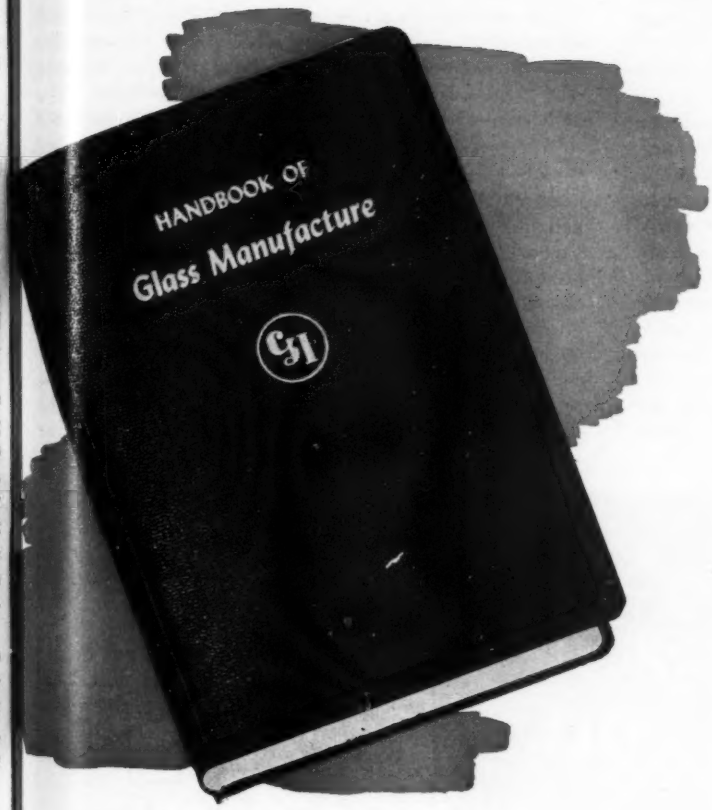
Paul A. Webster, Chief Chemical Analyst, Hartford-Empire Company, Division of Emhart Mfg. Company, died April 23 at the age of 52.

Affiliated with the Glass Division of the American Ceramic Society, Mr. Webster was the author of several papers dealing with the chemical analysis of glasses and raw materials. His development of short methods for analysis of glasses led to the standard procedures sponsored by the Glass Division and later adopted by American Society for Testing Materials. His latest contribution was a procedure for direct titration of boric oxide in glass.

Mr. Webster joined Hartford-Empire in 1933, having been employed previously at Solvay Process Company. He graduated from Cornell University in 1925, with a degree in Chemical Engineering.

It's *new*

and it's *different*



IT'S NEW because twelve years have passed since the first handbook for glass manufacturers was published and so much has taken place in the intervening years in technological and engineering development.

IT'S DIFFERENT because it is the only single volume where so much pertaining to all phases of glass manufacture will be found.

The NEW ***Handbook of Glass Manufacture*** is comprised of more than 500 pages of practical reference data . . . tables, charts, formulae, illustrations, and text. It is a primary working tool for plant executives, research heads, laboratory technicians, and engineers. It is a reference book that should be immediately available when you have a question or need a quick start to the solution of a problem. It is edited for glassmen by those who know glass.

Send for your *personal* copy now!

GJ

The Glass Industry
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Date .....

Enclosed please find remittance in the amount of $..... to cover the cost of ..... copies of the HANDBOOK OF GLASS MANUFACTURE. Single copy price, $11.50. Order for 5 or more copies, 10% discount. Add Shipping and Insurance charges, domestic 50c; foreign 80c. Foreign remittance in U.S. dollars.

NAME .....

COMPANY .....

STREET ..... CITY ..... STATE .....

Basic Refractories • • •
(*Continued from page* 315)

To summarize briefly the considerations which have led to the recommendation of high magnesia periclase refractories as the best brick at present for glass furnace regenerators, the following laboratory indications are confirmed by experience in many actual furnace installations: Resistance to chemical attack by the glass carry-over is materially increased as the silicate content of the basic refractories is decreased; The highest MgO content appears to give the best results; Refractory chrome ore is broken down by the carry-over or by the free magnesia content of the brick, or both together, under the conditions encountered in glass regenerators. It becomes extensively recrystallized, and bricks comprising chromite become very friable during such service.

The indications of a series of observations of basic checker installations over the past ten years may be summarized as follows: Increased usage of basic bricks in the regenerators leads to longer furnace campaigns, greater operating efficiency of the furnace, with fuel consumption substantially stable throughout the campaign, or greater production from a given furnace, and an over-all reduction of operating costs. Naturally, these advantages have not been secured soley through the increased usage of basic brick. The improvement has been aided materially by careful operating practices, including better compositions, better feeding and firing, and in some cases improved furnace design.

Operators may very well say that the foregoing is interesting and may show what can be done with basic refractories, but question whether they can afford the increased dollar outlay to replace fireclay checkers with basic. It is extremely difficult to pin down actual savings made possible by increased usage of basic bricks. Too many varying factors of furnace operation complicate the picture. However, in this connection it may be interesting to consider one set of comparative figures obtained on a glass furnace in two successive campaigns.

In the earlier campaign, the tank produced almost 80,000 tons of glass in a period of 22 months. The checker setting consisted of 23 courses of basic brick on top of 12 courses of super-duty and 12 courses of first quality fire-brick. At the end of the campaign, the checkers were approximately 50% plugged as a result of fluxing of the fireclay sidewalls and fireclay checkers. When the checker chambers of this furnace were rebuilt, the basic checkers were increased from 23 to 44 courses in depth, the area of the tank was increased ten per cent, and the main crown and regenerator crown were raised. An improved batch was developed, which gave somewhat better melting conditions.

As a result of these changes, increased production rates and greater efficiency have been noted. In the current campaign, in which more than 90,000 tons of glass have been produced, the consumption of natural gas for fuel has decreased from 7,920,000 BTU's per ton of glass in the previous campaign to 5,600,000, a decrease of almost 30%. Production has averaged approximately 130 tons per day or expressed in terms of melting area, 19.5 tons per 100 sq. ft. The indicated saving on fuel alone, in the present campaign over the previous, amounts to somewhat

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As I have said, this is not all attributable directly to the increased usage of basic brick. Nevertheless, confirmation which is beginning to be gathered, in the form of reports of increased efficiencies such as the one cited earlier, leads us to feel that at least a very considerable part of the economies may be credited to the refractories. In the furnace just discussed, further substantial savings have been realized as a result of eliminating at least one checker rebuild during the life of the glass tank.

Research Digest • • •

(Continued from page 322)

fusion-cast blocks are in any case such as to necessitate exposures of many hours with the equipment described, any marked lengthening of the source-film distance beyond a very few feet can quickly lead to an exposure time measured in weeks. The more nearly the radiation can be made to approach parallel-beam conditions (i.e., increasing the source distance), the more closely will the graduations and details of the gammagraph represent the actual sizes, in their true relative positions, of any discontinuities in the block. The working distance from source to film and the exposure time are, therefore, arrived at by a compromise and through trial exposures. The present arrangement for a 12-inch block is an exposure time of 50 hours and a cassette distance of 41 inches from the source.

The uncertainty regarding the cavity-film distance limits the information obtainable from a single gammagraph, but there is a reduction in uncertainty resulting from the taking of three gammagraphs of each block (one along each axis) or of stereogammagraphs. The most important pieces of information required about the cavities are their approximate distances from the "bottom faces" of the blocks and their general sizes. A single gammagraph has been found to give this information. By this means, blocks in which the effective thickness is inadequate can be segregated for use in positions in the glass tank furnace which are not subjected to the most severe conditions.

So far, only 18x12x8-inch blocks have been examined by the authors, and in practice it has been found that fusion-cast corundum-mullite blocks show a greater thickness of solid material between the cavities and the face than do fusion-cast corundum-zirconia blocks of this size.

For the heaviest duty in glass furnaces, fusion-cast corundum-zirconia is preferred to fusion-cast corundum-mullite, and more attention has accordingly been paid to the γ-ray examination of the former. An arbitrary minimum thickness of $3\frac{1}{2}$ inches of solid material between the cavities and the working face has been chosen for a first quality block of corundum-zirconia. Blocks which conform to this standard are classed as "A" quality. Blocks in which the thickness of solid material is less than $3\frac{1}{2}$ inches are classed as "C" quality. Very few "C" type blocks have so far been detected.

γ-ray examination has revealed that not all fusion-cast 18x12x8-inch corundum-zirconia blocks contain distinct cavities. A proportion, about one in eight, of those examined has been found to show no distinct cavities at all,

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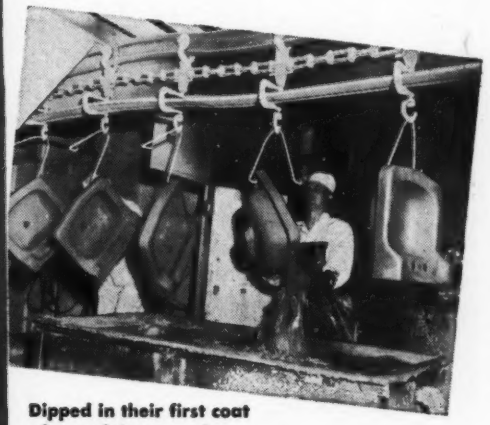

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or alternatively diffuse small cavities usually appear as striae in the gammagraph. Blocks of the type just mentioned are classed as "B" quality, and appear to be of a less dense texture than normal "A" blocks. It may be that such blocks have a distinct porosity or contain more glassy matrix than usual. It is not known how such blocks behave in service compared with the "A" type block. It is proposed to select "A" type blocks for the heaviest duty, particularly for use under the ports where wear is most severe on the top course.

G.C.M.I. Meeting • • •
(*Continued from page* 306)

assembled members.

Perfect golf weather prevailed for three days. The social events, including a cocktail party given by Foster-Forbes Glass Company, the ladies bridge party and the annual G.C.M.I. banquet, were, as usual, fully enjoyed by all.

Inventions and Inventors • • •
(*Continued from page* 321)

either mathematically or by dividing the total input power by the total effective area of the panel, and the uniformity of the film thereby ascertained.

The patent contains nine claims and the following references were cited: 939,109, Switzer, Nov. 2, 1909; 2,264,-968, De Forest, Dec. 2, 1941; 459,930, Germany, May 14, 1928; and 723,959, France, Jan. 23, 1932.

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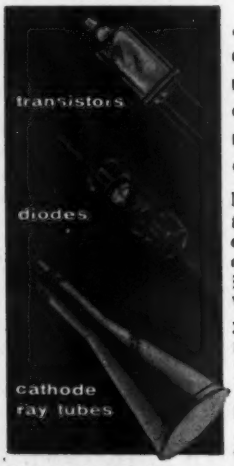

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L-O-F GLASS FIBERS

L-O-F GLASS FIBERS TRADEMARK

Shown above is the new trademark for the L-O-F Glass Fibers Company, which recently merged with Glass Fibers, Inc. Center section is symbolic of method for drawing fine fibers from molten glass. The new design will be the basic trademark applied to all company products.

WORK STABILITY STUDY FEATURES NEW GLASS CONTRACT

Larger companies and the production workers' union in the flat glass industry have agreed to make a year's special study of employment security and stabilization as a result of discussions of the guaranteed annual wage at negotiations recently concluded.

"The companies did not approve the Union's demand for a guaranteed annual wage and a guaranteed 40-hour work week, but agreed that each company in conjunction with the Union would conduct a study on employment and security stabilization," declared the joint statement issued by bargaining representatives of Libbey-Owens-Ford Glass Company, Pittsburgh Plate Glass Company and the United Glass & Ceramic Workers of North America, CIO-CCL. "The results of the studies will be submitted to the parties prior to wage negotiations in May 1956."

The new agreement, effective on the signing May 15, provides for a general wage increase of eight cents per hour with adjustments of eight cents and six cents per hour respectively for maintenance and non-bonus workers. In addition, insurance benefits were increased.

• The American Management Association's National Packaging Exposition will observe its silver anniversary next spring with the 25th annual showing of new developments in packaging, packing and shipping.

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GORDON CONFERENCE ON GLASS

As announced in the May 1955 issue of THE GLASS INDUSTRY, the Gordon Research Conference on Glass will be held August 15 through 19. Information concerning the activities planned for this Conference is obtainable from the University of Rhode Island, Kingston, Rhode Island. The Conference is scheduled to be held at Kimball Union Academy, Meriden, New Hampshire.

CORNING FELLOWSHIP ESTABLISHED

The Corning Glass Works has established a fellowship open to candidates for the Ph. D. degree in Engineering Science at the University of California. The fellowship is being offered to further fundamental research in the field of ceramic science. It will carry an annual stipend of $2000 for a single person, or $2500 for a married person. In addition, the fellowship will cover fees.

LITHIUM CORPORATION MAKES PRICE REDUCTIONS

Lithium Corporation of America, Inc. has announced a general price reduction effective immediately. Among the products affected are lithium carbonate, hydroxide and chloride lithium metal, lithium amide and hydride and nine special ceramic compounds.

The greatly expanded production made possible by the company's new chemical plant at Bessemer City, which is now shipping finished material and is soon to be in full production, will result in lower costs.

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AMERICAN WINDOW GLASS ELECTS NEW OFFICERS

Directors of the American Window Glass Company have elected Otto G. Schwenk as President and Chief Executive Officer of the company, succeeding Albert S. Crandon, who has been elected Board Chairman.

Mr. Schwenk was formerly Vice President of Blaw-Knox Company, and for four years prior to that served as a Director and Vice President in charge of Production of Yale & Towne Manufacturing Company. His business experience also includes four years with the Weatherhead Company in a variety of positions, including industrial engineer, controller, production manager and executive assistant to the president.

Mr. Crandon in his 32 years with American Window Glass has become a recognized authority on glass furnace design and operation. He will henceforth devote major attention to special technical activities associated with glass manufacturing at the company's several plants.

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